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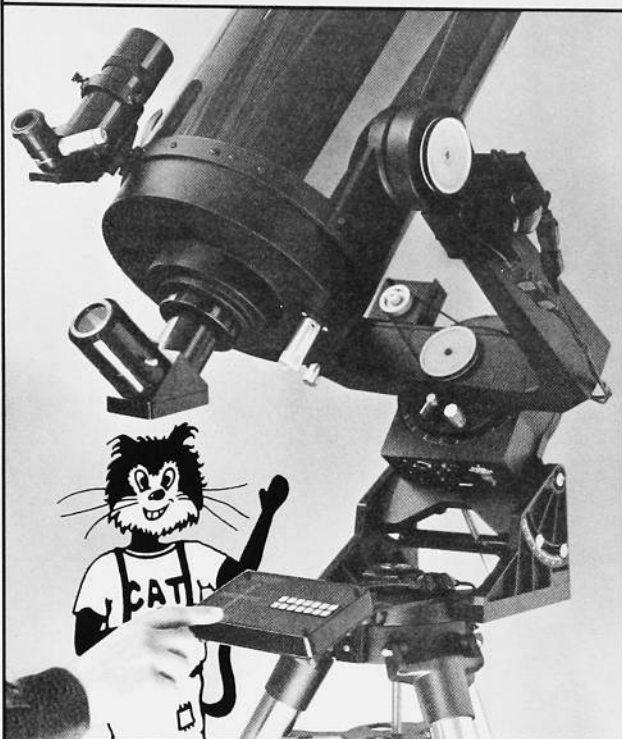


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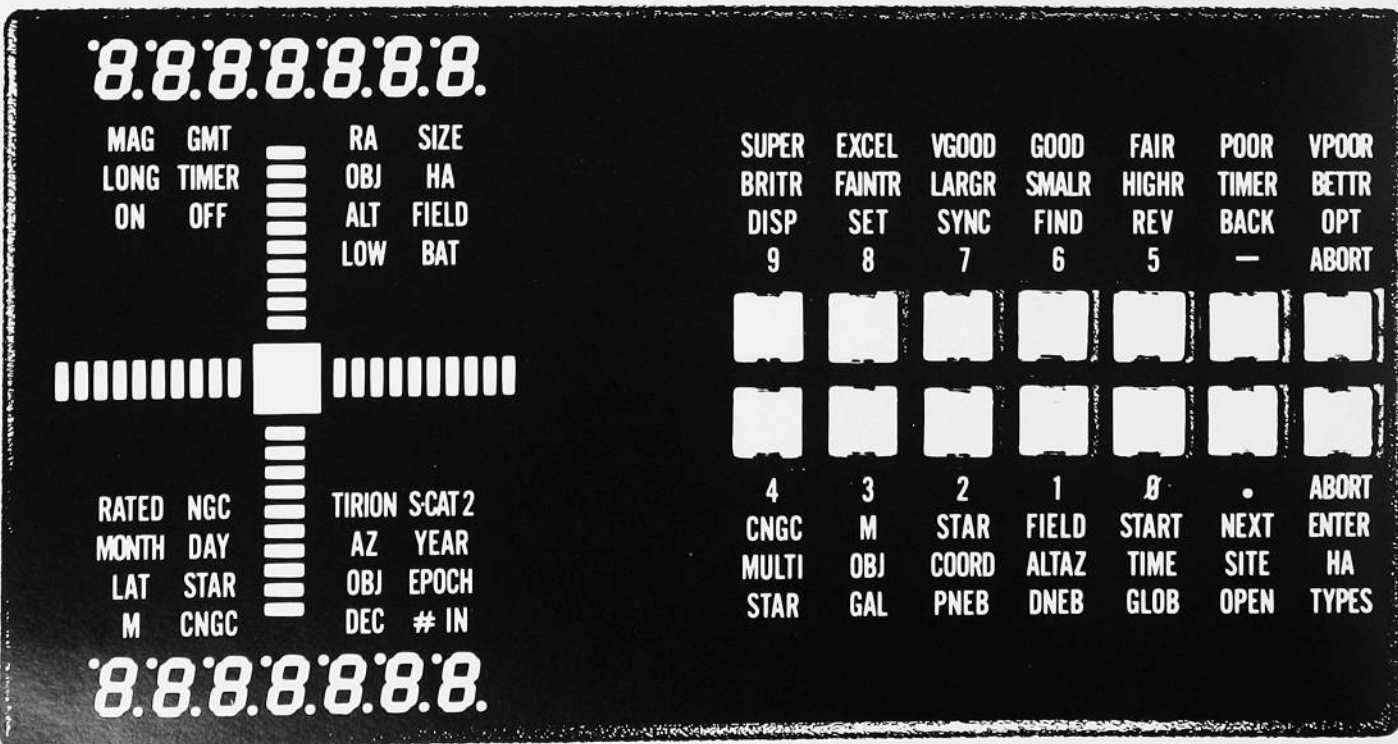
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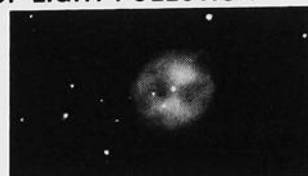
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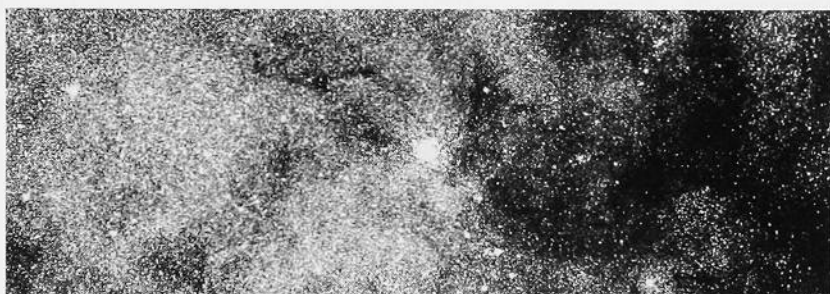
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5072, color slides from neg	36	\$6.95
D-19 B&W Developer	1 gal.	\$6.95

DEEP SKY



Surveying Autumn's Planetaries by Alan Goldstein

8 *Planetary nebulae can be some of the most intriguing telescopic objects in the sky with their widely varied shapes, colors, and sizes. NDSOS chief Alan Goldstein takes you on a tour of thirty-five of the planetaries visible in the autumnal evening sky.*



Scutum's Dazzling Star Cloud by Jim Barclay, Steve Coe, A. J. Crayon, George de Lange, Chris Schur, and David J. Eicher

14 *Although its boxlike shape covers only one hundred square degrees, Scutum the Shield lies in the thick of one of the Milky Way's brightest star clouds and contains many clusters for backyard telescopes.*



Fifty to the Pole! by Lucian J. Kemble

20 *What is the modern Canadian deep sky observer to do? Become hopelessly frustrated because he can't observe Sagittarius, Scorpius, and Centaurus in a dark, contrasty sky? "Hell no — fifty-four forty or fight!" — or maybe that's "fifty to the pole!"*

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ON THE COVER: M27, the Dumbbell Nebula in Vulpecula, photographed by Martin C. Germano, who used an 8-inch f/10 SCT, hypersensitized Tech Pan film, and a 60-minute exposure from Mount Pinos, California.

Inside View

Seeing's What It's All About

During my stay at the Texas Star Party last May my friend Ed Boutwell from Alabama, who graciously allowed me to use his telescope to sketch deep-sky objects, made some interesting remarks. "Dave," he started, "you wouldn't believe the fun I've had with my 16-inch Dobsonian over the past few days. If you really take the time to look hard at all of these galaxies, really study them carefully, you wouldn't believe the details you can see." Ed's remarks reflect the core challenge of modern deep-sky observing: the way you observe determines what you gain from the hobby.

I'm tired of hearing people say deep-sky observing is a parlor game, that finding objects and "collecting them" is a little like collecting beer cans or autographs. I'm tired of hearing pseudo-professional observers snobbishly say the act of observing galaxies is not an important part of amateur astronomy because it contributes nothing to science. Each of these arguments, for whatever reasons they were derived, simply misses the point.

You see, finding galaxies and nebulae in your telescope does not constitute deep-sky observing. It's only the first in the multiple-step process that is deep-sky observing. After you find an object, the challenge comes from using the combination of equipment and techniques that will allow you to see the most information you can with your telescope. Then, recording that information for posterity completes the process by providing a source of information for future reference. Cheapening an amateur astronomer's love of observing and recording nature around him by comparing it to collecting beer cans is nothing but a thoughtless smear, and peering down at those who don't wish to record light curves of stars but rather want to critically observe galaxies is sheer insecurity masquerading as stupidity. As the son of a scientist, I know you don't have to produce data to contribute to science; by experiencing the universe you're contributing to your own understanding of science.

Seeing's what it's all about. I don't

mean the quality of observing conditions and I don't mean just looking at the sky the way you watch television. I mean *seeing*, critically examining faint objects with a sharp, patient eye that can record subtle information about a deep-sky object.

This issue contains an unusual mixture of articles that should help you see my point more clearly. "DSM Reports" presents a piece on critical seeing by Boston's Jim Meketa. Also in this section is an article about sketching deep-sky objects by Australia's Gregg Thompson and a thought-provoking piece by Patrick Drigans.

The feature articles this fall collectively provide an enormous number of objects for you to observe. Alan Goldstein's piece on planetary nebulae in the fall sky details thirty-five such objects and includes complete data for each little sphere of gas. The second feature was produced by a group of Arizona amateurs working with Jim Barclay in Australia and describes or provides data for sixty-eight deep-sky objects in this tiny constellation. Also included in this article are maps to zero in on Scutum and its deep-sky wonders and a companion piece by Canada's Alister Ling about so-called nonexistent objects in Scutum. The third feature article describes Canadian amateur Lucian J. Kemble's observing project of viewing objects between +50° declination and the north celestial pole.

Next issue we'll take a look at piggyback photography of deep-sky objects, take an exhaustive tour through Monoceros, examine the bizarre nature of FU Orionis stars, discover a novel method for locating objects, and go in search of the Clown Nebula. Until then, remember that successful deep-sky observing ultimately means seeing carefully and enjoying yourself out under the stars.

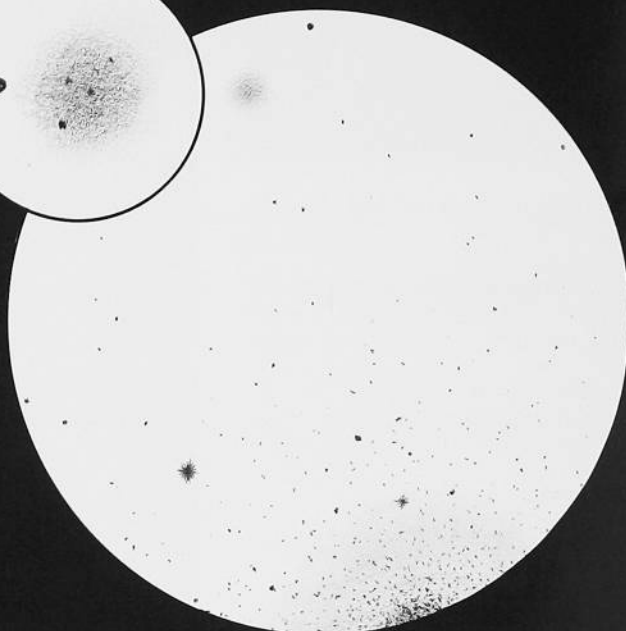
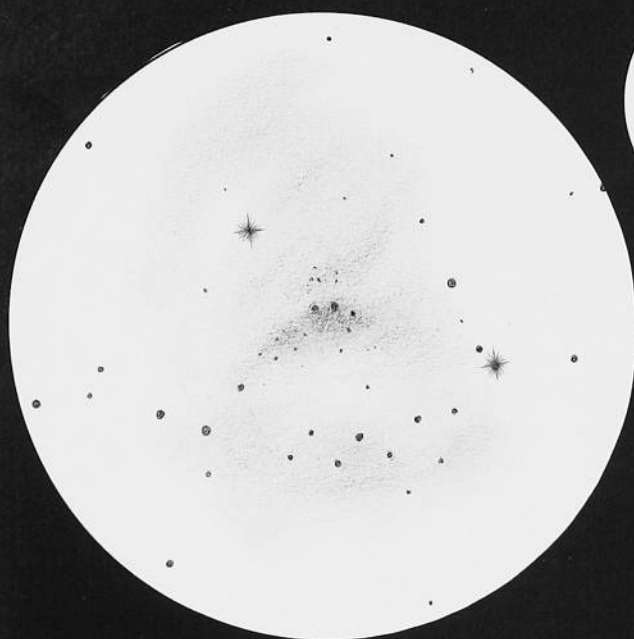
Yours truly,



Dave Eicher
Editor-in-Chief

Letters to DSM

Mystery Emission Nebula



Mystery Double Globular, Showing Closeup of Background Globular

Attention Deep-Sky Experts!

Dear Dave / Enclosed are three sketches of two fascinating objects that may intrigue your readers.

The first is a huge emission nebula that is so bright, keen-eyed observers can glimpse it with the naked eye. It is easily visible with the slightest optical aid and is prominent in 7x50 binoculars. Because it is so bright, it is overexposed on the U.K. Schmidt telescope blue plate, but the drawing reveals the nebula's inner structure and associated stars. It must contain a great deal of doubly ionized oxygen as well as hydrogen because it appears bright when viewed through an OIII filter. Its brightness lets the nebula stand fairly high magnification under a dark sky.

This object is so bright one would assume it is well known, yet relatively few observers know about this object. What is its designation and where is it located?

The second object is the bluest globular cluster in the sky. If that doesn't make it interesting enough, it lies behind the outlying members of a brighter globular cluster. The blue cluster is quite small and faint and unresolved in the 12-inch telescope used to make the drawing. The high-magnification drawing reveals some faint stars not visible in the larger scale

sketch. Note that four very faint, star-like impressions appeared in the cluster at the observer's threshold of vision. They could be star clumps or foreground stars. Where can this fascinating double globular be found?

Gregg D. Thompson
7 Strover Court
Springwood,
Queensland, Australia 4127

— Can any reader identify these two "mystery objects?" DJE.

Supernova Slip

Dear Sirs / Excuse me for pointing out a date error in the caption to the supernova photograph of NGC 5850 on page 6 of your Spring 1987 issue, which suggests that Rev. Bob Evans discovered that supernova on the same night Ian Shelton did. As a correspondent of Rev. Evans, I find in his letter to me of March 13, 1987: "But, after the frustration of narrowly missing the discovery of 1987A in the LMC, I found a very faint one two days later . . . in NGC 5850 in Virgo."

The caption points out that the NGC 5850 supernova was announced on the IAU Circular #4321, which is a curious coincidence of numbers. The supernova

I discovered on April 18, 1979, was in the galaxy NGC 4321, better known as M100.

Double stars as well as galaxies interest me. On page 33 of the spring issue the third component of ADS 8220 (90 Leonis) was not mentioned. It shines at magnitude 8.7 and lies 63" away from the main pair, so it is easily visible at low powers. My 2.4-inch f/8.3 Unitron refractor resolves the close pair and shows the third component at 50x, but 71x provides the best view of all three stars. Your table gives the ADS number as 8820, while the text gives 8220. *Sky Catalogue 2000.0* and the *Atlas of the Heavens Catalogue* use the latter.

But these are minor errors. This issue was a delight to read. Keep up the good work.

Gus Johnson
RD 2, Box 67
Swanton, MD 21561

Publish All the Data!

Dear Mr. Eicher / I would like to compliment you on an excellent issue of *Deep Sky* (Winter 1986), especially the article by Robert Reeves on photographing the northern Milky Way. This subject was intriguing and the article was accompanied by out-of-the-ordinary

astrophotographs. However, I would like to make a complaint about the frequent practice (in both *Deep Sky* and *ASTRONOMY*) of publishing photos without the technical details of how they were taken.

For example, the cover of the winter 1986 *Deep Sky* has a photo of the Rosette Nebula taken with a 300mm lens and a 30-minute exposure, but the caption doesn't provide the lens focal ratio. My experience suggests this must have been a Schmidt camera or another extremely fast system. Another photo of the Rosette appears in the April 1987 issue of *ASTRONOMY*, this one taken with a 200mm lens and a 26-minute exposure. The result is rather faint. I have photographed this object with an ordinary 400mm f/6.3 telephoto lens and had to use extremely long exposures to get good results.

To assess what I can expect from my equipment and how what I do compares with the best work of others, full details on published pictures are necessary.

In any case, I enjoy seeing the excellent astrophotos published in your magazine, especially those taken with wide-field cameras.

Robert A. Mulford
Johnson Weil Observatory
1529 Valencia Road
Schenectady, NY 12309

— Dear Mr. Mulford: You've set me up beautifully to ask all photographers who submit work to please include all relevant photographic data on each slide or print or, at the very least, in a letter that accompanies submissions. If everyone would do this, we could provide all helpful data not just almost all the time but all the time.

— DJE

How about Something on Nebular Filters?

Dear Dave / The other day I was leafing through issues of *Deep Sky Monthly* (remember it?) and the May 1982 issue caught my eye. I read it through quite thoroughly, enjoying every article again. That issue contained a very exciting article about nebular filters by Jack Marling. But part two of that article never appeared because the May issue was the last. I was disappointed that part two of this article never showed up in *Deep Sky*.

Perhaps you can feature that article or another like it again. I think it would be very useful for those of us who don't know what non-light-polluted skies are.

Steve Farkas
1008 Old Farm Trail
Medina, OH 44256

— Dear Steve: We will certainly run more articles on LPR filters. I would like to run a piece comparing those actually on the

market at present, model by model. Does anyone want to write such a piece? — DJE

Quasar Request

Dear Mr. Eicher / In "Scanning the Literature" by Brian Skiff in the spring issue, Mr. Skiff stated that if twenty-five readers sent you a note by July 1, you would publish a story with the whole scoop on quasars. Please do, even if you don't get twenty-five letters. And include more than just one quasar (like 3C 273). Give the top five or ten quasars with finder charts to observe with small scopes.

Thank you for your great magazine.

Yancy Shirley
1416 Belvedere Drive
Kokomo, IN 46902

— Hear that contributors? Get crackin'!

An Identity Crisis for IC 2948?

Dear Dave / One night while observing deep-sky objects in Centaurus, I attempted to find IC 2948, listed in *Sky Atlas 2000.0* as an open star cluster a little southeast of Lambda Centauri. When I observed the area with a 16.5-inch f/4.3 Newtonian, I was unable to find any hint of a star cluster at IC

Sketch by Gregg Thompson



2948's position with either low or high magnification. I did, however, notice a magnificent rich field of Milky Way stars and a large region of nebulosity. With an OIII filter this nebulosity is quite pronounced. The brightest portions of this nebula form an 'L' shape and can be seen without the filter under a dark sky.

I enclose a drawing of the region. The nebula was so large that to see it with Lambda required the use of my wide field 2" 32mm TeleVue eyepiece. Note that the nebula IC 2944 surrounding Lambda (the bright star on the north-western edge of the field) is not visible.

Apparently the ESO catalogue also states that IC 2948 is an open cluster. Could it be that the nebula is IC 2948? Can any reader shed light on this apparent anomaly?

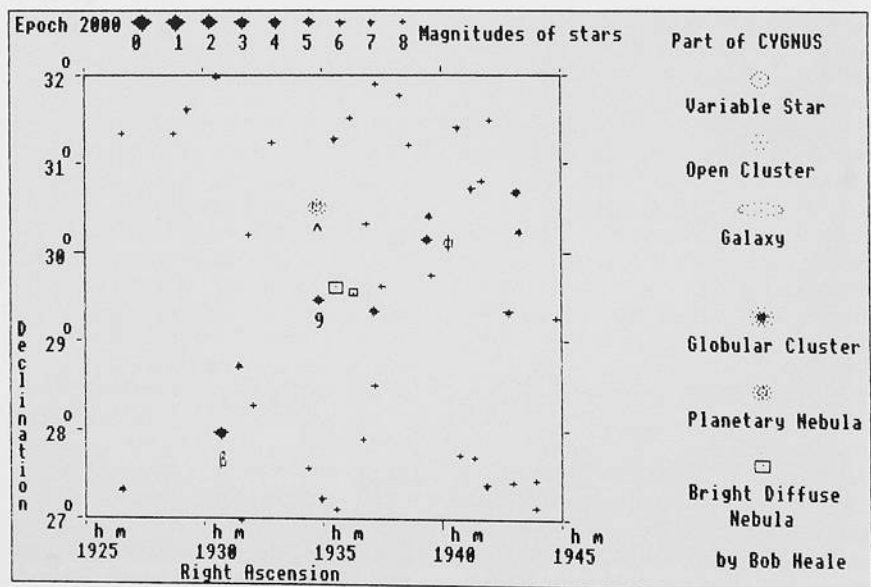
Gregg D. Thompson
7 Stroker Court
Springwood,
Queensland, Australia 4127

Custom Chart for Campbell's Star

Dear Dave / I am a 39-year-old amateur astronomer and have 6-inch and 10-inch Newtonian reflectors. I belong to the local astronomical group, the Astronomical Society of Frankston, and occasionally produce computer-generated star charts for them.

I read with great interest the letter from Sweden's Soren Jensen in *Deep Sky* #15. His desire for large-scale finder charts for planetary nebulae struck a chord. I also noted in the same issue that Campbell's Star is a good example of a faint planetary, and so I produced the enclosed chart, which I hope *Deep Sky* readers will enjoy.

Bob Heale
37 Warana Way
Mount Eliza,
Victoria, Australia 3930



Surveying Autumn's Planetary Nebulae

by Alan Goldstein

Planetary nebulae offer many challenges for observers with virtually any size telescope. For small telescope users, many bright planetaries show subtle structure and central stars that can be glimpsed under good seeing. For large telescope users, faint planetaries almost unheard of by amateurs twenty years ago dot the sky, offering the chance to spot the last wisp of light from a dead star. For astrophotographers, planetary nebulae rarely if ever recorded on film by amateurs abound, waiting to have their celestial portraits taken.

Because the material forming planetaries is normally puffed off spherically, we see a typical planetary nebula as a disk. Some planetaries show more exotic shapes, however. Rings occur when more material lies in the outer part of the shell than in the inner part. Other planetaries appear as "antirings" and are bright in the middle and relatively faint toward the edge. Disks illuminated asymmetrically are not uncommon and often have high enough surface brightnesses to be visible in small scopes. Of course, as with galaxies and most other celestial objects there are the exceptions: warped, disturbed, irregular planetaries that defy morphological explanation.

A planetary nebula is a transient phenomenon, lasting between 30,000 and 100,000 years between formation and complete dissipation. Stars that form planetary nebulae usually weigh in at around one solar mass. It is extremely likely that the Sun will become a planetary nebula after exhausting its supply of nuclear fuel about 5 billion years from now.

Planetary Nebula Observing Tips

Small planetaries need to be observed with special filters that transmit the triply ionized oxygen (OIII) line. To identify a small planetary with such a filter, you repeat observations with and without the filter, and the nebula will appear to "blink on" when the filter is

in place. Another technique for observing small planetaries is using a prism that reveals the planetary nebula's spectrum, a bright-line emission spectrum. However, the prism has limitations where the filter does not: the prism has trouble showing spectra for very faint planetaries.

Fortunately for city-bound observers, planetary nebulae can be observed in skies one might not normally consider "normal" for deep-sky observing. Of course a dark sky is better than a relatively bright sky, but because they have reasonably high surface brightnesses, it is possible to observe most planetaries from moderately light-polluted locations. The small disk of a typical planetary nebula bears magnification well and remains visible in a sky where a galaxy or an emission nebula is impossible to see.

You will need an aperture of at least 6 inches to see planetaries in a poor sky. At the high magnifications necessary to see the disks of small objects, the sky will usually appear reasonably dark in the eyepiece. You may be pleasantly surprised at how many small planetaries are visible from suburbia or even from inside a small city.

Many planetaries have extremely faint central stars that require the largest backyard telescopes to be seen. Despite this, don't let published magnitudes prevent you from at least looking for faint central stars. Several years ago at the Texas Star Party I saw a central star catalogued at fainter than 16th magnitude with a 12.5-inch telescope. (I suspect the star actually glows at about 15th magnitude.) The difficulty of seeing faint central stars — compounded by the fact that the human eye is not very sensitive to blue light — makes hunting for them an unpredictable game. However, this unpredictability makes searching for them exciting.

I've used a variety of instruments to observe planetaries over the years and find I like to use the 11-inch Schmidt-

Cassegrain telescope at the University of Louisville's Moore Observatory. I prefer to sketch all the planetaries I observe, keeping them in an organized notebook. The 11-inch scope makes this easy because it is accurately polar aligned and has a very nice drive; observations at very high power can be made without continually moving the instrument.

As a general rule I suggest that when you are looking for small (diameter less than 25") planetaries, you should sweep at 100x. This magnification separates the nebulae from stars. For stellar planetaries you'll have to employ the prism or nebula filter. I have been known to sweep at 300x before, but do this only with a 9mm Nagler eyepiece because of the great eye relief and wide field. Most of my recent planetary nebula sketches were made with a 4.8mm Nagler, which yields 600x. Admittedly the star images are terrible at this tremendous magnification, but the planetary nebula disks are so much larger it doesn't matter.

Some Autumnal Planetary Delights

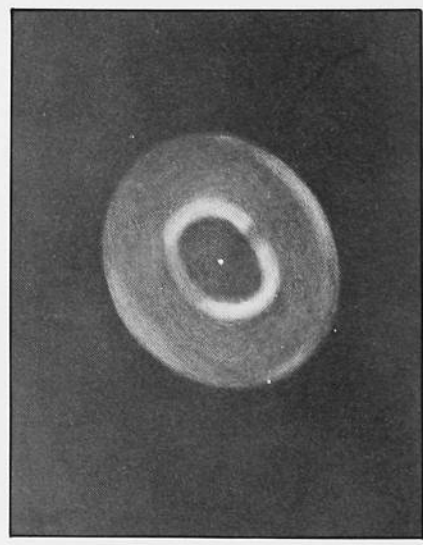
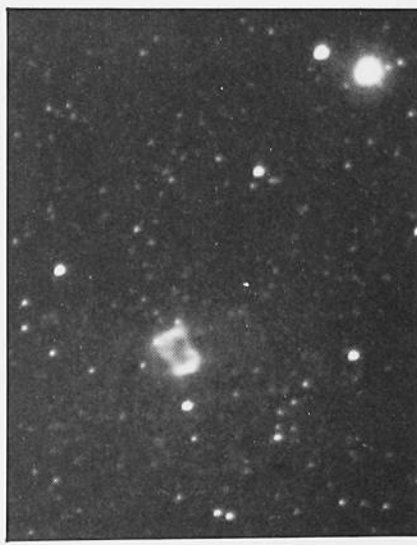
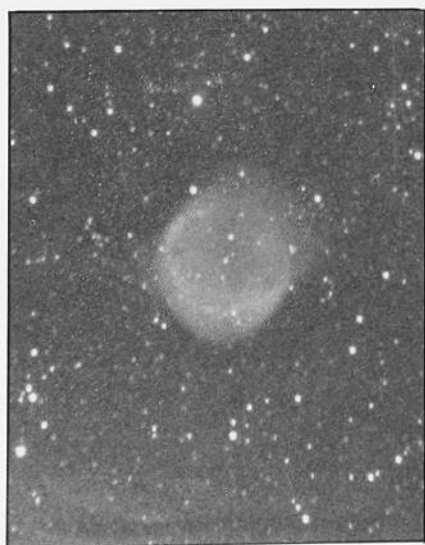
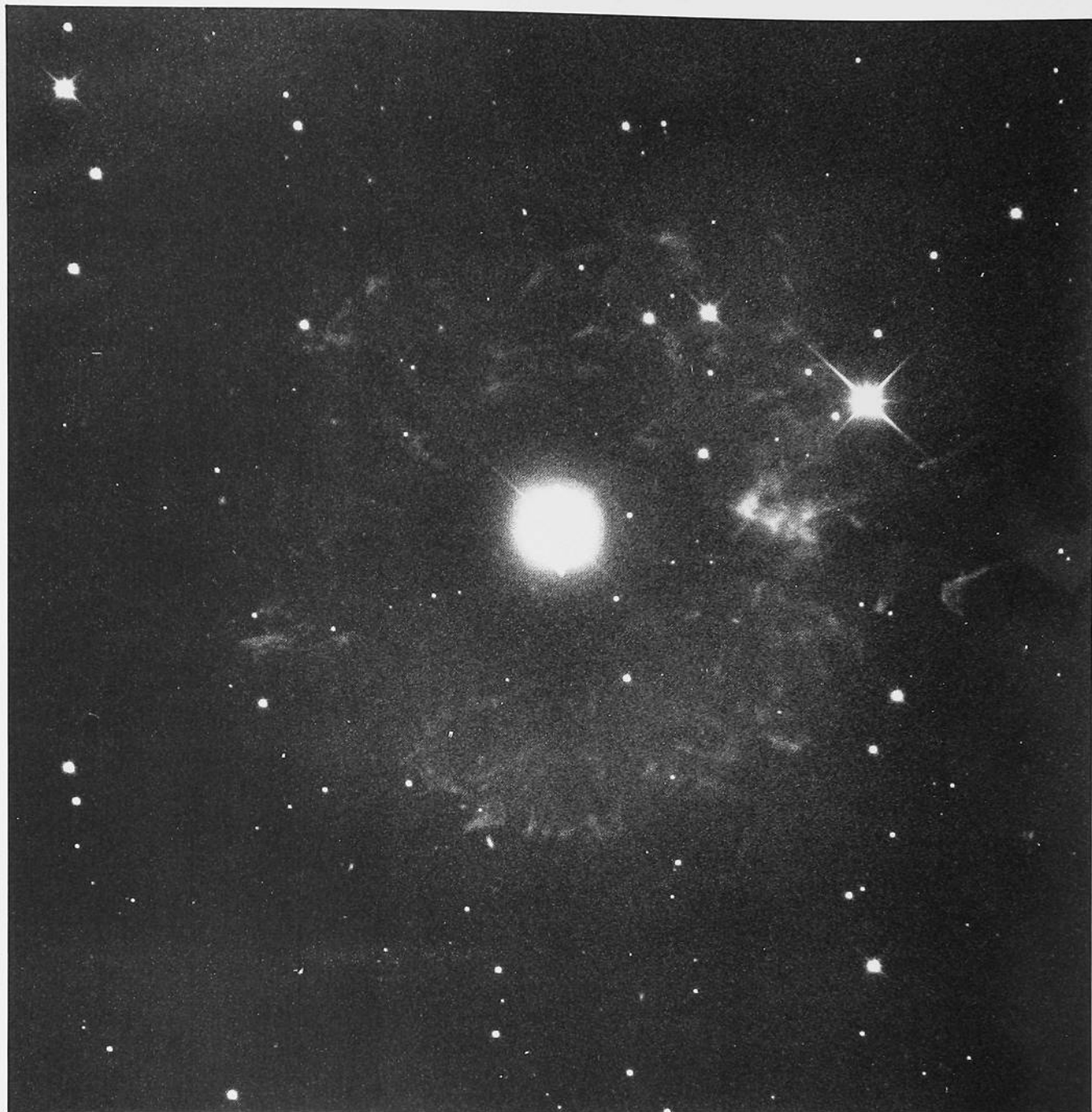
The following notes describe some of the most fascinating planetary nebulae visible in the fall sky.

- **NGC 6058** is located slightly east of center on a line drawn between Lambda (λ) Corona Borealis and 14 Hercules. This planetary's small disk is circular, fairly faint, and contains a magnitude 13.8 central star. NGC 6058 is located in a rich field of stars and requires high magnification to be seen well. Epoch 2000.0 position: 16h 04.4m, +40° 41' (Hercules). Photographic magnitude: 13.3. Diameter: 23". V magnitude of central star: 13.8. Distance: 2.6 kpc.

- **IC 4593** is nearly four times

Although they are fun to observe and often show amazing detail, planetaries like NGC 7009 are tiny, so use high powers when seeing permits. Photo by Tom Dessert (10-inch f/6 Newtonian, 103a-F film, 16-minute exposure).





smaller than NGC 6058. Located on the Hercules-Serpens Caput border, this tiny nebula lies 4.5° west and 2° south of Omega (ω) Herculis. IC 4593 lies within a triangle of 6th-magnitude stars easy to pick up in a finder scope. This planetary's central star is nearly as bright as the nebulosity, so very high power is needed to see the disk well. An extremely faint shell of material 120'' in diameter surrounds this nebula — can astrophotographers record it? Pos.: 16h 12.2m, +12° 04' (Her). Pht. mag.: 10.9. Diam.: 12''/120''. V mag. ★: 11.3. Dist.: 2.0 kpc.

• **NGC 6210** is the brightest planetary nebula in Hercules. It is located a third of the way between the stars 51 and Beta (β) Herculis. NGC 6210's small disk shows no detail, and its 13th-magnitude central star is difficult to spot because of the bright nebulosity. Pos.: 16h 44.5m, +23° 49' (Her). Pht. mag.: 9.3. Diam.: 14''. V mag. ★: 12.9. Dist.: 1.1 kpc.

• **NGC 6309**, the brightest planetary in Ophiuchus, is located 1.5° west of Nu (ν) Serpentis. It is small and appears clearly oval in backyard telescopes: it is nearly twice as long as it is wide. The faint central star is difficult to see, but I once suspected seeing it with an 8-inch scope in the Mojave Desert. Can the 66''-diameter outer shell be recorded by astrophotographers? Pos.: 17h 14.1m, -12° 55' (Ophiuchus). Pht. mag.: 10.8. Diam.: 14''/66''. V mag. ★: 14.4. Dist.: 2.6 kpc.

• **NGC 6369**, the second brightest planetary nebula in Ophiuchus, is conveniently located 30' west-northwest of 51 Ophiuchi. This object appears as a disk in small telescopes, but 6-inch or 8-inch scopes show it as a miniature Ring Nebula. It measures 30'' across, approximately the size of the hole in the Ring Nebula. After you locate NGC 6369, carefully check its color. It should appear to be pale blue. Like NGC 6309, this object has a 66''-diameter faint outer shell beyond the reach of visual observers but could be photographed by skillful hobbyists. Pos.: 17h 29.3m, -23° 46' (Oph). Pht. mag.: 12.9. Diam.: 30''/66''. V mag. ★: 14.7. Dist.: 1.2 kpc.

• **NGC 6439** is a faint, difficult-to-

observe planetary found near the Sagittarius-Serpens Cauda border between the star cluster M23 and Xi (ξ) Serpentis. NGC 6439 glows at magnitude 13.8 and measures a mere 5'' across, which forces you to use high power on a night of steady seeing to spot it. A star of approximately equal magnitude lies close by. Pos.: 17h 48.3m, -16° 29' (Sagittarius). Pht. mag.: 13.8. Diam.: 5''. B mag. ★: 18.5. Dist.: 5.0 kpc.

• **NGC 6445** lies 4.5° south of NGC 6439 and 30' north of the magnitude 9.7 globular cluster NGC 6440. (Planetary NGC 6445 and globular NGC 6440 form an exceptionally pretty pair when viewed with low or medium magnifications.) NGC 6445 has an odd, twisted shape and a low surface brightness that makes studying it at high power a challenge. It is slightly longer than it is wide, measuring 34'' across its long axis. Give this object some careful consideration on your next night of observing, and you may find observing it quite enjoyable. Pos.: 17h 49.2m, -20° 01' (Sgr). Pht. mag.: 13.2. Diam.: 34''. B mag. ★: 19.1. Dist.: 1.4 kpc.

• **NGC 6543** is a circumpolar planetary for many North American observers. This planetary is located in the middle of a squashed rectangle of stars with Omega (ω) and 27 Draconis on one side and 26 and 42 Draconis on the other. NGC 6543 has a 18''-diameter disk that shines at magnitude 8.8 and shows an obvious blue-green color in small telescopes. The 11th-magnitude central star is not particularly difficult to see. Large backyard telescopes, those over 12 inches in aperture, may show some unusual structural detail in NGC 6543 if used at very high power. An extremely faint 6'-diameter shell made of gaseous wisps surrounds the disk. Pos.: 17h 58.6m, +66° 38' (Draco). Pht. mag.: 8.8. Diam.: 18''/350''. V mag. ★: 11.4. Dist.: 1.1 kpc.

• **NGC 6537** is a very small nebula in Sagittarius. If you found NGC 6439 too challenging, you'll be glad to know this nebula is slightly larger than NGC 6439 and much brighter. It lies near a 7th-magnitude star midway between M23 and Mu (μ) Sagittarii. Small scopes show this object as a tiny disk surrounded by a rich starfield. Pos.: 18h 05.2m, -19° 51' (Sgr). Pht. mag.: 12.5. Diam.: 9''. Dist.: 1.2 kpc.

• **NGC 6565** is a relatively small, dim planetary. This object is a ring planetary but appears as an oval disk in all but very large telescopes. NGC 6565 is easy to find, lying 2.5° northeast of Delta (δ) Sagittarii; the planetary forms a triangle with Delta and Gamma (γ) Sagittarii. It is located between 7th- and 8th-magnitude stars that are easy to pick up in a finder scope. Pos.: 18h 11.9m, -28° 11' (Sgr). Pht. mag.: 13.2. Diam.: 9''. Dist.: 3.0 kpc.

• **NGC 6572** lies a little more than 2° south-southeast of 71 Ophiuchi. At magnitude 9.0 this 8''-diameter disk is the brightest planetary in Ophiuchus. In medium- or large-aperture scopes NGC 6572's sharply defined oval disk shows a strong blue-green color. This object bears magnification well and can be observed at very high magnifications. The central star is easy to see. Pos.: 18h 12.1m, +6° 51' (Oph). Pht. mag.: 9.0. Diam.: 8''. V mag. ★: 13.6. Dist.: 0.6 kpc.

• **NGC 6567** is a tiny but bright planetary located 2° north of Mu Sagittarii. My observations indicate that it consists of a round 8''-diameter disk. Pos.: 18h 13.7m, -19° 05' (Sgr). Pht. mag.: 11.7. Diam.: 8''. B mag. ★: 15.0. Dist.: 1.2 kpc.

• **NGC 6629** is nearly three times the size of NGC 6572 and one magnitude fainter. The central star of this planetary glows at magnitude 12.8 and is visible in small scopes under a dark sky. This object can be found 2.3° north and 30' west of Lambda Sagittarii. Pos.: 18h 25.7m, -23° 12' (Sgr). Pht. mag.: 11.6. Diam.: 15''. V mag. ★: 12.8. Dist.: 1.9 kpc.

• **M57** (NGC 6720) is the Ring Nebula in Lyra, the most observed planetary nebula in the sky. Located about two fifths of the distance between Beta and Gamma Lyrae, the Ring is large and bright, offering a plain smoke-ring shape to viewers with 6-inch and larger telescopes. M57 appears distinctly oval in 8-inch telescopes and the dark "hole" quite prominent. In 12-inch and larger instruments the central hole appears to be filled with very faint nebulosity (which of course it is, because the nebula is a sphere), which makes the 15th-magnitude central star difficult to see. I repeatedly suspect seeing the central star in an 11-inch telescope, and it is definitely visible in 16-inch and larger scopes under a dark sky when the seeing is good. An extremely faint shell of material encircles the Ring Nebula at a distance of 150''. Pos.: 18h 53.6m, +33° 02' (Lyra). Pht. mag.: 9.7. Diam.: 70''/150''. V mag. ★: 14.8. Dist.: 0.6 kpc.

• **NGC 6741** is one of several fine planetaries in Aquila. To find this object, sweep 3.3° north of 14 Aquilae; the nebula lies in a rich starfield. This object is a ring-shaped nebula, but I've never seen it as anything more than an oval disk. Pos.: 19h 02.6m, -0° 27' (Aquila). Pht. mag.: 10.8. Diam.: 6''. V mag. ★: 14.7. Dist.: 1.6 kpc.

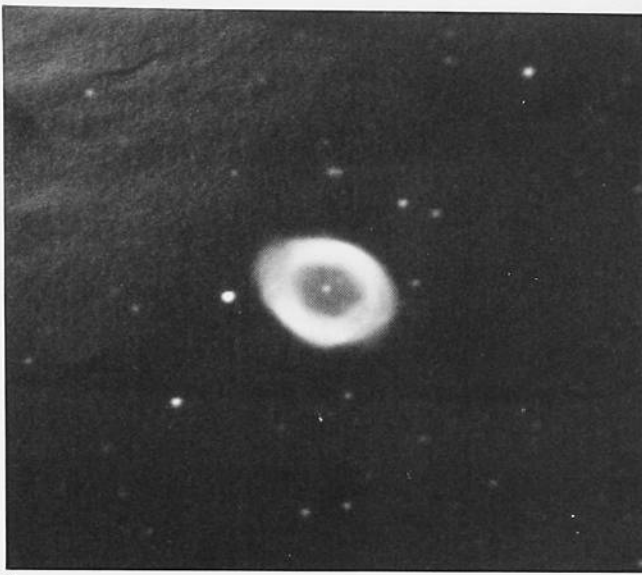
• **NGC 6751** lies at the apex of an equilateral triangle consisting also of Lambda and 12 Aquilae, about 1.3° away from each star. This planetary is less than 30' from the deep red, semi-regular variable V Aquilae. With a large telescope the color contrast between these objects is fascinating! Glowing at

Opposite top: Planetary nebulae like NGC 6210 in Hercules have large, faint outlying loops of nebulosity. Lick Observatory photo.

Opposite left: NGC 6781 in Aquila. Photo by Jack B. Marling (24-inch f/9 Cassegrain, 60-minute exposure).

Opposite center: NGC 6445 in Sagittarius. Photo by Martin C. Germano (8-inch f/10 SCT, hypersensitized Tech Pan film, 50-minute exposure).

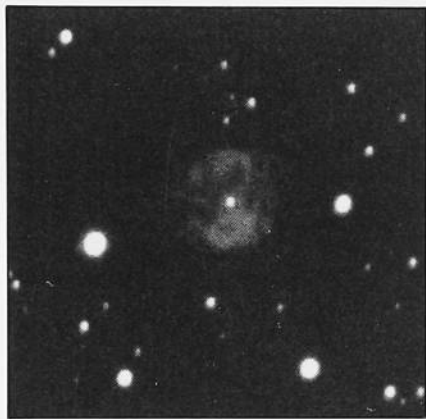
Opposite right: E. E. Barnard made this sketch of NGC 7662 in Andromeda with the 40-inch refractor at Yerkes Observatory in Wisconsin. Courtesy University of Chicago.



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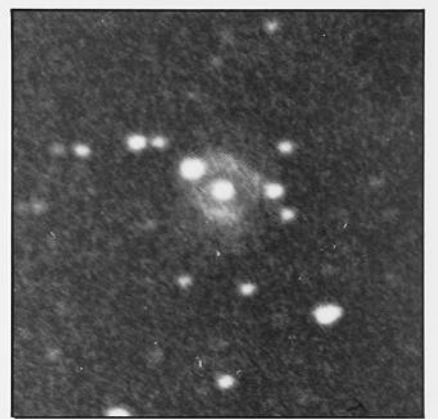
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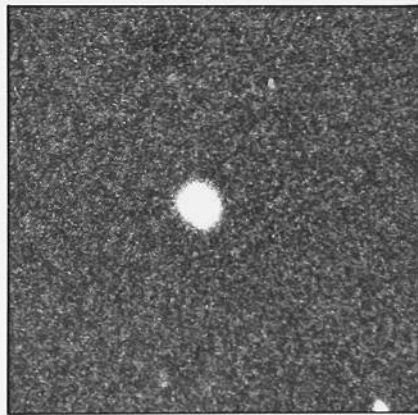
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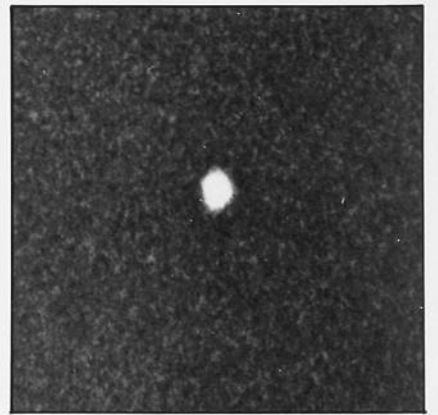
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1. M57 photographed by Rick Dilsizian.
2. NGC 6826 photographed by Jack B. Marling.
3. NGC 6905 photographed by Jack B. Marling.
4. NGC 6751 photographed by Jack B. Marling.
5. NGC 6804 photographed by Martin C. Germano.
6. NGC 6772 photographed by Martin C. Germano.
7. NGC 6210 photographed by Martin C. Germano.
8. NGC 7027 photographed by Martin C. Germano.

magnitude 12.5, NGC 6751 is easily visible in 6-inch and larger scopes. Pos.: 19h 05.9m, $-6^{\circ} 00'$ (Aql). Pht. mag.: 12.5. Diam.: 20". V mag. $\star$: 13.9. Dist.: 2.0 kpc.

• NGC 6772 should be called the "Ghost of Aquila." At magnitude 14.2 and with a diameter of 62" this planetary has such a low surface brightness it is invisible in telescopes smaller than 8 inches in aperture. Try spotting this 1'-diameter patch of fuzzy light midway between Lambda and 27 Aquilae. Pos.: 19h 14.6m, $-2^{\circ} 42'$ (Aql). Pht. mag.: 14.2. Diam.: 62". B mag. $\star$: 18.4. Dist.: 2.8 kpc.

• NGC 6781 is the "ring nebula of Aquila." This object is one of the most beautiful planetary nebulae in the sky, showing a delicate, unevenly illuminated ring shape in telescopes of 6 inches or more aperture. NGC 6781 is visible as a roundish blob of light in a 3-inch scope and is rather easy to locate since it lies 1.6° north and 30' east of 22 Aquilae. A 6th-magnitude star lies 30' west of this fine planetary nebula. Pos.: 19h 18.4m, $+6^{\circ} 33'$ (Aql). Pht. mag.: 11.8. Diam.: 106". V mag. $\star$: 15.0? Dist.: 0.8 kpc.

• NGC 6804 is a moderately large (31" diameter) planetary also found in

Aquila. At magnitude 12.2 this object is rather faint, appearing as a pale disk in small scopes. The magnitude 14.2 central star can be glimpsed with large backyard instruments. Look for NGC 6804 1.6° north and slightly west of Mu Aquilae just southwest of a 7th-magnitude double star. A faint 1'-diameter shell surrounds this object. Pos.: 19h 31.6m, +9° 13' (Aql). Pht. mag.: 12.2. Diam.: 31"/66". V mag. ★: 14.2. Dist.: 1.3 kpc.

• **NGC 6818** is the brightest planetary nebula in Sagittarius, glowing at magnitude 9.9. With a 6-inch or larger telescope the annular appearance of this planetary is obvious. This object lies north of a trio of 5th-magnitude stars (in part 54 and 55 Sagittarii) and about 40' north-northwest of the irregular galaxy NGC 6822. Pos.: 19h 44.0m, -14° 09' (Sgr). Pht. mag.: 9.9. Diam.: 17". V mag. ★: 13.1. Dist.: 1.6 kpc.

• **NGC 6826**, the "Blinking Planetary," lies 30' east of 16 Cygni. This nebula closely resembles the well-observed NGC 2392 in Gemini in most respects. Unlike NGC 2392, however, NGC 6826 displays a curious optical effect only reported with a handful of other planetaries (none as bright as NGC 6826). The next time you observe NGC 6826, try staring at the nebula with direct vision and then switch to averted vision. With direct vision you'll see only the magnitude 10.4 central star, and with averted vision you'll see just the nebula. By rapidly switching between direct and averted vision, you'll make the nebula blink. You can also have fun with the Blinking Planetary's color. One time I observed NGC 6826 with a 21-inch f/5 Cassegrain telescope; the nebula appeared a beautiful pale green. When the nebula "blinked off," the central star became a vivid green, as if it soaked up color from the nebula! This object has an extended shell measuring 140" across. Pos.: 19h 44.8m, +50° 31' (Cygnus). Pht. mag.: 9.8. Diam.: 30"/140". V mag. ★: 10.4. Dist.: 1.0 kpc.

• **M27** (NGC 6853) is the Dumbbell Nebula in Vulpecula, perhaps the most observed planetary after the Ring Nebula. The Dumbbell is conveniently located 30' south of the star 14 Vulpeculae and can easily be found by star hopping from Albireo. M27 is visible in binoculars and appears as a large oval haze in small telescopes. An 8-inch telescope shows the full extent of its dumbbell shape, and large backyard telescopes — 12-inch or 16-inch instruments, depending on the sky conditions — show fabulous detail in the bright nebulosity and two "ears" of fainter milky light at right angles to the dumbbell shape. M27's central star glows at magnitude 13.9 and is rather difficult to spot because of the foreground nebulosity. A large scope under a very dark sky,

however, shows the central star and several others projected on the nebula's surface. The Dumbbell measures 350" across but its faint halo of nebulosity extends to 15'. Pos.: 19h 59.6m, +22° 43' (Vulpecula). Pht. mag.: 7.6. Diam.: 350"/910". V mag. ★: 13.9. Dist.: 0.3 kpc.

• **NGC 6879** is a distant, faint nebula in Sagitta. Glowing at 13th magnitude, this 5'-diameter spot of light is a challenging object. NGC 6879 lies in a rich starfield slightly less than 2° west-northwest of 14 Sagittae. Pos.: 20h 10.5m, +16° 55' (Sagitta). Pht. mag.: 13.0. Diam.: 5". V mag. ★: 15 (photographic). Dist.: 5.1 kpc.

• **NGC 6884** is slightly larger and slightly brighter than NGC 6879. NGC 6884's 6" disk bears magnification well and shows a slight brightening toward the center. This is probably not caused by the central star, however, which glows softly at magnitude 15.6. To find NGC 6884, look 30' south-southeast of the star Omicron¹ (o¹) Cygni. Pos.: 20h 10.4m, +46° 28' (Cyg). Pht. mag.: 12.6. Diam.: 6". V mag. ★: 15.6. Dist.: 2.8 kpc.

• **NGC 6886** is another small planetary, spanning only 4". The game here is to differentiate NGC 6886 from the surrounding field stars with a prism or nebula filter. The sole feature of this nebula appears to be an oval shape at a magnification of 600x. NGC 6886 lies 1.6° east of Eta (η) Sagittae. Pos.: 20h 12.7m, +19° 59' (Sge). Pht. mag.: 12.2. Diam.: 4". V mag. ★: 15.7. Dist.: 3.1 kpc.

• **NGC 6891** is one-half magnitude brighter than NGC 6886. This planetary is very much elongated with a long dimension of 12" and a faint outer shell measuring 72". The central star is readily visible in moderate size telescopes, as it glows nearly as bright as the nebula itself. To find NGC 6891, look 2.5° south of Rho (ρ) Aquilae. Pos.: 20h 15.2m, +12° 42' (Aql). Pht. mag.: 11.7. Diam.: 12"/72". V mag. ★: 12.4. Dist.: 2.2 kpc.

• **NGC 6905** is located in northern Delphinus about 4° east of Eta Sagittae. (Look for a line of 6th- and 7th-magnitude stars nearby.) Shining at magnitude 11.9, NGC 6905 is visible in small telescopes without too much difficulty. This object measures 46" across and is surrounded by a field of faint stars. Pos.: 20h 22.4m, +20° 07' (Delphinus). Pht. mag.: 11.9. Diam.: 46"/100". B mag. ★: 13.5. Dist.: 1.3 kpc.

• **NGC 7009** is one of two bright planetaries in Aquarius. Shining at magnitude 8.3 and measuring 25" across, NGC 7009 has a high enough surface brightness to show distinct blue-green color in any telescope. Small scopes show it as a slightly oval disk; 10-inch or larger telescopes at extremely high power can show faint ansae, or

extensions, on two sides of the nebula. These ansae gave NGC 7009 its popular nickname, the Saturn Nebula. Search for this object 1.3° west of Nu Aquarii. Pos.: 21h 04.2m, -11° 22' (Aquarius). Pht. mag.: 8.3. Diam.: 25"/100". V mag. ★: 12.3. Dist.: 0.9 kpc.

• **NGC 7026** is one of the most elongated planetary nebulae in the sky, measuring 21" by 5". This object isn't easy to find, because it glows dimly at magnitude 12.7 and lies in one of the richest areas of Cygnus Milky Way. Look for it 13' north of 63 Cygni. Pos.: 21h 06.3m, +47° 51' (Cyg). Pht. mag.: 12.7. Diam.: 21". V mag. ★: 14.5. Dist.: 1.7 kpc.

• **NGC 7048** is a large circular nebula in Cygnus. Spanning 1' and glowing at magnitude 11.3, NGC 7048 is easy to find despite its location in a rich starfield. NGC 7048 lies midway between the stars 60 and 71 Cygni. Pos.: 21h 14.2m, +46° 16' (Cyg). Pht. mag.: 11.3. Diam.: 61". B mag. ★: 18.3. Dist.: 1.2 kpc.

• **NGC 7293** is the famous Helical Nebula in Aquarius. The largest and closest planetary nebula, the Helix is nearly one quarter the size of the Full Moon and is visible under a dark sky as a pale disk of gray light in large binoculars or short-focus telescopes. With a 6-inch scope the annular shape is obvious, although the dark central "hole" appears partially illuminated. A 12-inch or larger scope at low power shows the dark hole and with averted vision reveals subtle structure in the Helix nebulosity. The Helical Nebula lies slightly more than 1° west of Upsilon (υ) Aquarii. Pos.: 22h 29.6m, -20° 48' (Aqr). Pht. mag.: 6.5. Diam.: 769". V mag. ★: 13.5. Dist.: 0.1 kpc.

• **NGC 7662** is the only planetary nebula in Andromeda visible in amateur telescopes and has a very high surface brightness. Shining at magnitude 9.2 and measuring only 20" across, NGC 7662 appears as a bright blue disk at high powers. It lies less than 1° south of 13 Andromedae. Pos.: 23h 25.9m, +42° 33' (Andromeda). Pht. mag.: 9.2. Diam.: 20"/130". V mag. ★: 13.2v?. Dist.: 1.2 kpc.

These planetaries represent the best and brightest visible in the fall sky. Many others are visible, though some only in large telescopes. Still others are too faint to be detected visually but could be photographed by amateur astronomers. Future articles will continue to highlight planetary nebulae, and we hope to hear about readers' observations.

Alan Goldstein is an expert deep-sky observer, founder of the National Deep Sky Observers Society, and a contributing author to Deep Sky Observing with Small Telescopes.

Scutum's Dazzling Star Cloud

by Jim Barclay, Steve Coe, A. J. Crayon, George de Lange,
David Fredericksen, Chris Schur, and David J. Eicher

Staring up at the fall Milky Way as it stretches from Sagittarius in the south to Cassiopeia in the north, you can spy an especially rich clump of nebulosity to the northeast of Sagittarius. This is the dazzling Scutum star cloud, one of the richest areas of Milky Way nebulosity in the sky. Johannes Hevelius named this area Scutum to honor Prince John Sobieski's shield, which symbolically protected Poland from the invading Turks in the 1600s. Originally this area of sky was the constellation Antinous, and you get a strange feeling if you run across this constellation in an antiquarian book. In fact, not until 1930 when the International Astronomical Union drew up "standard" constellations was Antinous all but forgotten.

Scutum covers a mere 108 square degrees of sky; only four constellations occupy less space in the sky than Scutum. However, what Scutum lacks in size it makes up for in deep-sky treats. The Scutum star cloud is a magnificent naked-eye sight under a dark sky. The constellation holds Delta (δ) Scuti, the prototype of a class of important variable stars, and R Scuti, an intensely red RV Tauri star. The diminutive constellation also holds many star clusters, including bright, splashy M11 and a slew of faint planetary nebulae.

If you have binoculars or a short-focus telescope with a wide field, be sure not to neglect the **Scutum star cloud** as a whole. In 10x50 binoculars the western edge of the star cloud seems brightest; with an RFT, dark lanes cut through this region and are visible even at low power. With an 8-inch f/4.5 scope at 35x, it is possible to see obscuring clouds of dark nebulosity extending from the cloud out into the Milky Way for about three degrees. After studying the details visible in the Scutum star cloud, don't miss casually sweeping the cloud with low-power binoculars as you sit in a lawn chair. A slow sweep from

the tail of Scorpius to the Cygnus star cloud will reveal our Galaxy at its best. From the Southern Hemisphere you can start at the Coalsack in Crux and sweep slowly overhead, continuing to Cygnus down on the northern horizon.

NGC 6649 is a 9th-magnitude open cluster in west-central Scutum. This object is visible in 10x50 binoculars as a bright patch in the Milky Way. Measuring 6' across, this group packs in fifty stars of magnitudes 11.6 and fainter and lies at a distance of 1.3 kiloparsecs. A 17.5-inch scope shows about twenty stars in a rich field with many apparent dark lanes trailing off in all directions. Australian observer Jim Barclay observed this cluster with a 12-inch scope and considered it easy to pick out from the Milky Way background.

Open cluster NGC 6664 is easy to locate, as it lies less than 1° east of Alpha (α) Scuti, shines at magnitude 7.8, and covers 16' of sky. This group's brightest members glow at magnitude 10.2 and are easily visible as distinct stars in small telescopes. A wide-field eyepiece allows you to fit this cluster and Alpha Scuti within the same field of view, although to observe the faintest cluster members you may want to use moderate magnifications and move the bright star out of the field. Twenty relatively bright stars are visible in 10-inch and 12-inch scopes. A 17.5-inch scope shows a sprinkling of very faint stars on exceptionally dark nights. Curiously, NGC 6664 is intrinsically larger and brighter than NGC 6649, because they lie at the same distance.

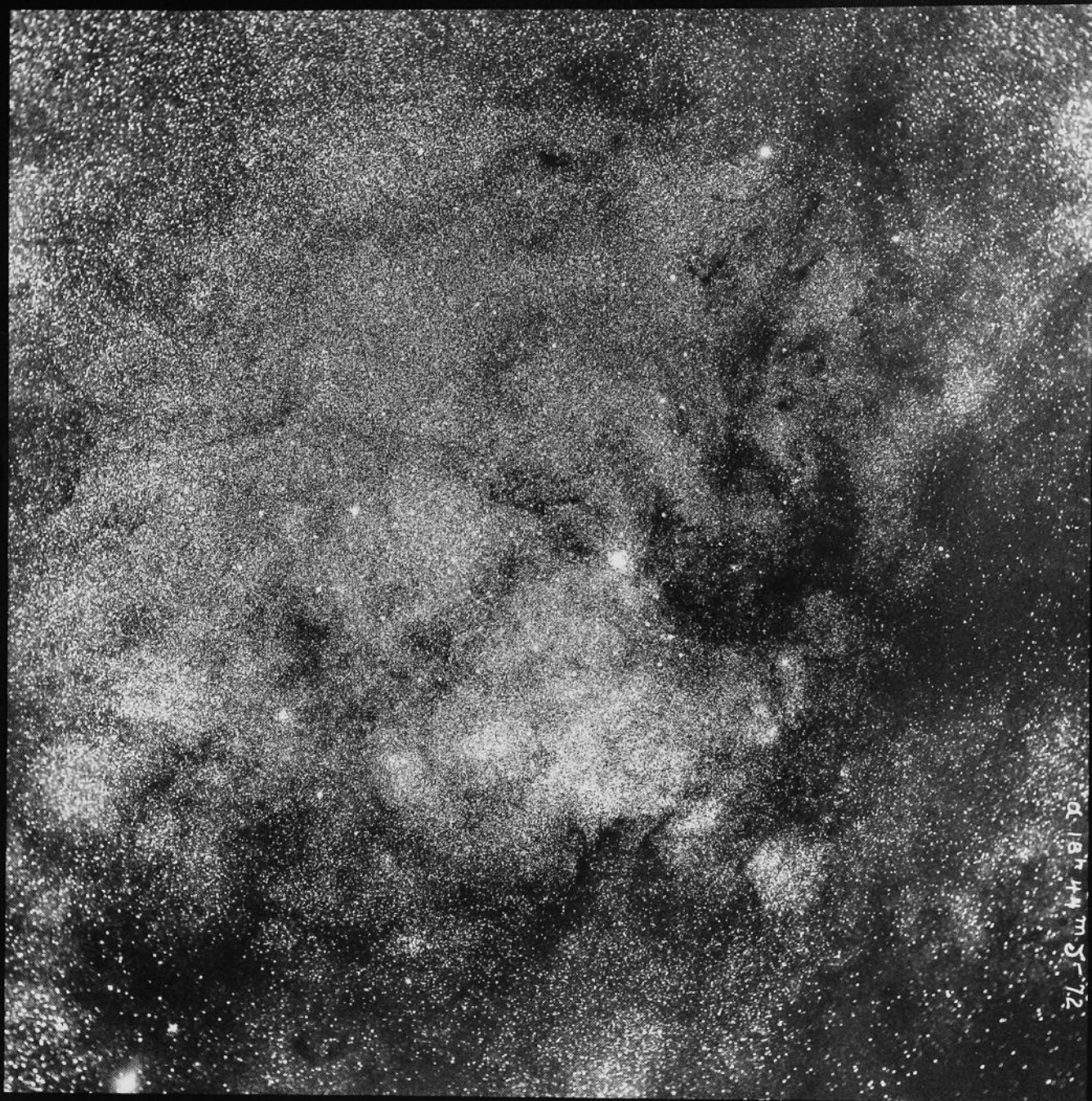
NGC 6683 is an open cluster located 2.5° southwest of Beta (β) Scuti. This object is rather difficult to pick out, because it lies on the bright western edge of the Scutum star cloud. This group has a photographic magnitude of 9.5 and contains twenty stars in an area 11' across. Unfortunately NGC 6683's brightest stars glow softly at magnitude 11.7 and are easily lost in the multitude

of faint stars composing the star cloud. After an hour of searching, the Arizona group (Coe, Crayon, de Lange, Fredericksen, and Schur) failed to identify this cluster but managed to narrow down the possibilities to three choices. Can anyone positively identify this group?

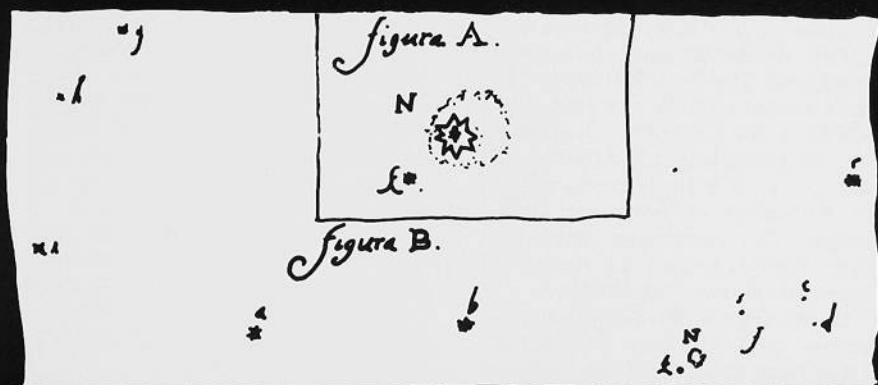
M26 (NGC 6694) is one of the finest objects in this region of sky. Charles Messier discovered this fine open cluster on June 20, 1764, and described it as a "cluster of stars near the stars η & θ Antinoi between which there is one which is brighter; with a three-foot [focal length] telescope they cannot be distinguished, a good instrument must be used. This cluster contains no nebulosity." In 1777 Johann Elert Bode published his "Complete Catalogue of Nebulous Stars and Star Clusters" in the *Astronomisches Jahrbuch* for 1779. In it Bode published positions of clusters and nebulae discovered by various astronomers. Bode himself discovered five deep-sky objects: M53, M64, M81, M82, and M92. Bode described M26 simply as a "star cluster with nebulosity."

Visually M26 is a delight. A finder scope or a pair of binoculars shows the group as a nebulous smudge with a few bright stars involved. Telescopically M26 appears as a coarse group of a few bright stars — the brightest shines at magnitude 10.3 — and a dozen rather dim members. The stars collectively shine at magnitude 8.0 and cover 15' and are arranged in a curved row. The Arizona group was pleased with M26, but Jim Barclay in Australia was delighted. He saw M26 as a cluster "reminiscent of NGC 4755," the Jewel Box in Crux. The total cluster membership is perhaps thirty stars, and the group lies 1.6 kpc away.

NGC 6704 lies slightly over 1° south-east of Beta Scuti and contains thirty stars of magnitude 12.2 and fainter in an area spanning 6'. This group's total magnitude is 9.2, which makes it easy to spot in binoculars and finder scopes



D. 18h 42m 32s



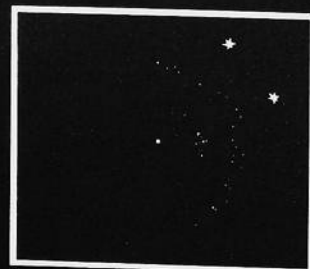
Above: Scutum recorded by Barnard;
below left: Kirch's discovery of M11;
below right: Smyth's observation of M11.

DCLXIV. 11 M. ANTINOI.

R. 18^h 42^m 32^s PREC. + 3^s.22

Dec. S 6° 27'.2 — N 3^s.69

MEAN EPOCH OF THE OBSERVATION . . . 1835.57



*Occultatio Stella fixae 3 magnitudinis, in ore Tauri, in Bayeri Uranometria
triangula, notata, observata Lipsiae, anno 1681, die 12 Decembris. 22. 1681.*

as a small spot of misty light. In 10-inch, 12-inch, and 17.5-inch apertures NGC 6704 appeared as a group of twenty stars arranged in a fish-hook shape. A wide-angle eyepiece shows the cluster is located within a dark ring of obscuring matter in the Milky Way.

M11 (NGC 6705), gem of the Scutum star cloud, was discovered on September 1, 1681, by the German astronomer Gottfried Kirch. An early observer

of variable stars and observer at the Berlin Observatory (of which he later became director), Kirch published a series of *Ephemerides* at Leipzig between 1681 and 1690. In the 1682 edition he included a note in the appendix about a "nebulous star discovered in Ganymede [Scutum]." Kirch's article is an early commentary on the starry nature of some faint nebulous patches and makes fascinating reading before

observing M11. Remember that this account's mention of the discovery of M22 by J. A. Ihle is relatively recent news, having occurred only sixteen years before. Kirch's account follows in entirety:

*Nebulous Star observed near
the Northern Foot of Ganymede,
Leipzig, Sept. 1st, 1681.*

Nonexistence at the Edge of the Scutum Star Cloud

The overwhelming number of stellar images on the Palomar Observatory, *Sky Survey (POSS)* in the vicinity of the Scutum star cloud is astonishing. Masses of faint stars eradicate patterns of reasonably bright stars visible in backyard telescopes. On the northwest corner of the star cloud the Great Rift slopes through Scutum, isolating smaller star clouds. Three of these clouds have NGC or IC designations but are not recognized as physically bound clusters. So they were tagged as Class 7 ("nonexistent") objects in the *Revised New General Catalogue*. If you view some of these so-called nonexistent clusters, however, you may have pretty good reason to believe they exist.

One particular advantage of observing Scutum is that it lies high enough to remain relatively unaffected by horizon haze and light pollution. Furthermore, it offers clusters that challenge a range of instruments. My interest concentrates on the northwestern edge of the Scutum star cloud.

To observe some of these unusual clusters, start at 4th-magnitude Beta (β) Scuti. Just 40' west-southwest of this star is a low surface brightness condensation that appears round. The surrounding area is laced with these condensations. Moving 45' west-northwest of this spot brings you to an undesignated dark nebula, roughly oval in shape and elongated north-south. In a 12.5-inch scope the complete lack of stars is striking. The *POSS* shows a fine haze of stars fainter than 16th magnitude in the area, and this may account for the absence of this object in Barnard's catalogue. A 60mm refractor at 14x does not show this hole. This is unfortunate, because the little dark nebula is an excellent reference point for all the objects that follow.

As strange as it may seem, the *Smithsonian Astrophysical Observatory* star atlas shows the open cluster NGC 6682 in this spot, so the *RNGC* lists NGC 6682 as nonexistent. John

Herschel described NGC 6682 as a "large, pretty rich cluster of straggling stars, having a vacuity in the middle and broken into 2 or 3 clusters. Fills field. 70 or 80 stars of all magnitudes from 10 to 18 counted. Extended, in parallel. The most compressed part is following." It so happens that 30' west of this spot is an object fitting Herschel's description. Both Harold Corwin of the University of Texas and Brian Skiff of Lowell Observatory agree that we have finally matched the name to the face from the crowd of surrounding clusters.

I was so surprised the *RNGC* did not pick up this simple coordinate error that I had to refer to the *POSS* prints. Instead of an obvious cluster where NGC 6682 lies, there is a 1°-diameter star cloud and the NGC cluster is a mere condensation inside it! A discerning eye and a 60mm aperture will reveal this cloud, but a wide field is necessary to boost the contrast between the star cloud and the surrounding background sky.

Half a degree south of the dark region lies the first section of **IC 4768**, described in the *Index Catalogue* as a "cluster, double, stars scattered." This northern section appears as a rich cloud elongated in p.a. 80°. The second component, only 15' south, is more round and contains a row of bright stars oriented north-northeast to south-southwest. The Great Rift lies just to the east, and immediately west of IC 4768 is a thin strip of dark nebosity. The result is that IC 4768 stands out so well it is easily recognizable in binoculars or low-power telescopes. The coordinates given for this object represent the midpoint between the two star clouds.

Observers with medium-size telescopes who can tear themselves away from the bulk of the Scutum star cloud will find **NGC 6683** 40' to the south-southeast. This 11'-diameter cluster lies in a rich starfield and was consequently less visible than the IC pair in a 12.5-inch

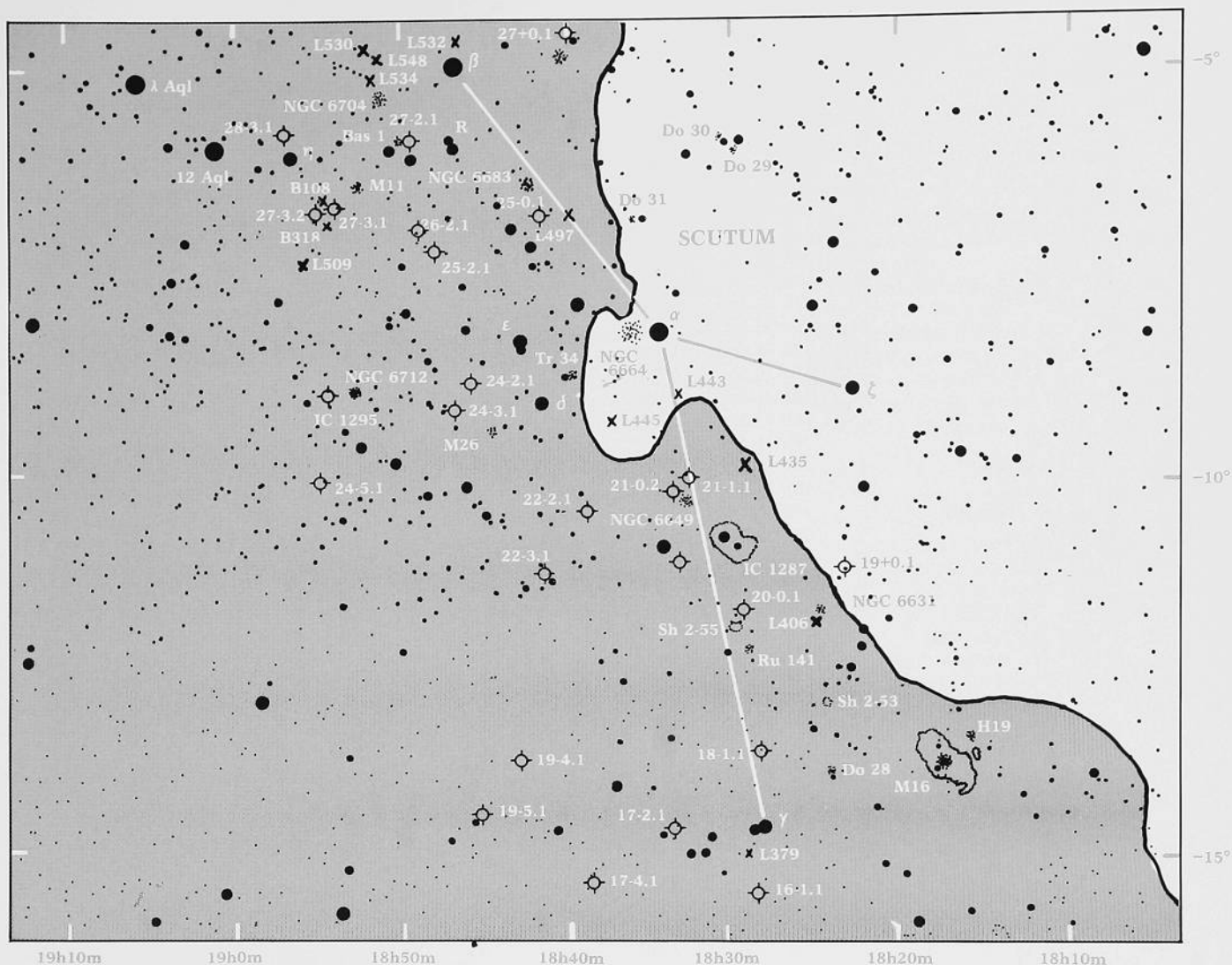
scope. "Nondescript" was the word that came to mind when I saw it. I failed to see NGC 6683 in the 60mm refractor. Almost more evident is a round star cloud some 15' across located 20' southwest of NGC 6683. This star cloud contains a neat double star near its center. As a challenge, try spotting three faint star clouds situated between NGC 6683 and IC 4768 and aligned roughly east-west. These areas are easily visible on the *POSS* but have eluded me thus far. Can anyone spot them?

Starting back at the dark nebula, move 45' and slightly west to find **Dolidze 32**. Elongated in p.a. 90°, Dol 32 is easily resolved into thirty or forty stars at low power in the 12.5-inch scope but shows no distinctive patterns. However, it does contain a clump of stars on its northwestern edge. East of the dark nebula is a trapezoid of stars with a 30' baseline. Around the closest vertex to the north is **Dolidze 34**, a difficult cluster to identify. Its rating of poor is indeed appropriate. I found three stars surrounding a bright central star. Several arcminutes east is a small, faint group just visible in the 12.5-inch scope.

Dolidze 33 is the most elusive "cluster" of the bunch. At first I couldn't find it at all. After referring once again to the *POSS*, I found a very faint, loose grouping that was difficult to sort out from the background. According to Brian Skiff, this object may result from an "absorption hole," a region of thin dark nebosity that allows background stars to shine through. It is unlikely that Dol 33 and Dol 34 are real clusters.

About 20' northwest of Dol 34 is the easily recognizable cluster **Trumpler 35**. Low powers show this object as an oval cluster elongated in p.a. 120° and enclosing three bright stars. Easily resolvable at high powers, the cluster is more populous near the "central star."

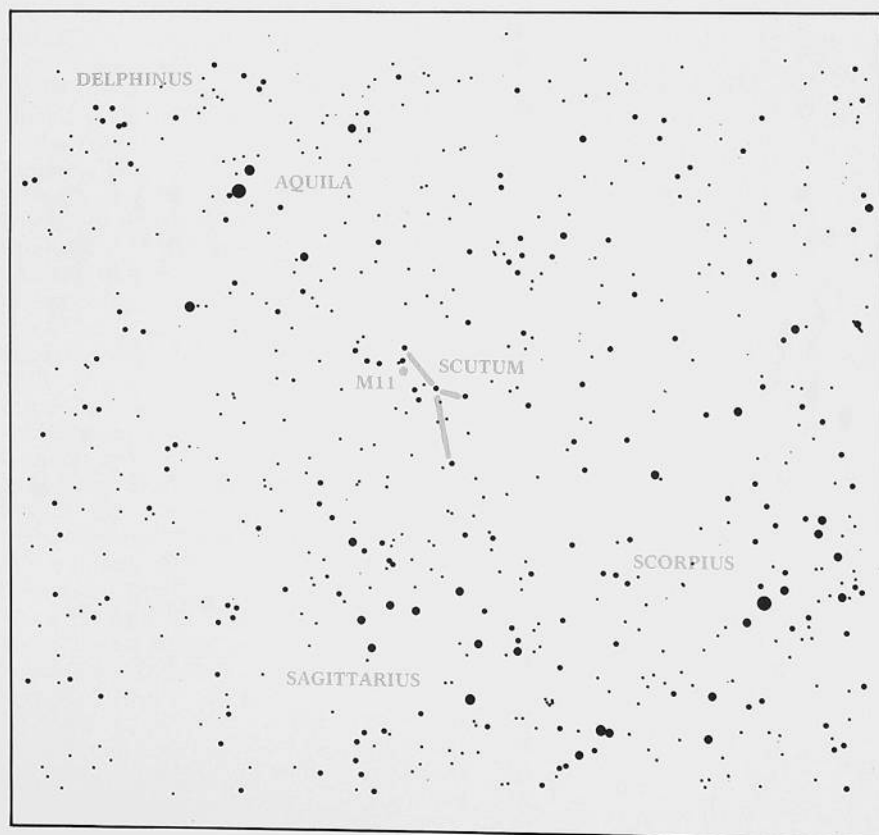
It can be great fun trying to pin down the identities of open clusters. Why not see if you can observe objects John Herschel first described 150 years ago? — *Alister Ling*.



Although early astronomers have listed several nebulous stars in the heavens, nevertheless, in the place of the so-called nebulous stars, the telescope shows us clusters of minute bright stars. Only three true nebulae have been discovered by star-lovers: the first, in Andromeda's girdle, first noticed by Simon Marius, the second in Orion's sword, found by Christian Huyghens in the telescope in 1656 and a third in Sagittarius which John Abraham Ihle discovered in 1665; afterwards, however, we established that it had been reported a little

Right: Scutum is well placed in the southwest for early evening viewing in autumn. Look for it between Aquila and Sagittarius, south of a prominent curved row of stars that includes Beta Scuti.

Above: A map of Scutum showing stars down to about magnitude 10 and deep-sky objects listed in the table on page 18. The map covers the area of sky between the "Scutum arc" to the north and M16 in Serpens to the south. The wavy gray line indicates the Milky Way border; east of this line the Milky Way is dense and west of the line it thins out. Dark nebula centers are marked by crosses. All the planetary nebulae in Scutum except IC 1295 are very faint and extremely challenging visual targets. Maps by David J. Eicher.



DEEP SKY WONDERS OF SCUTUM

Object	Type	R.A. (2000)	Dec.	Mag.	B-V	Mag.★	Size/Sep./Per.	Distance	N★
ADS 11282 (Σ2306)	★ ^M	18h 22.2m	-15°05'	7.9, 8.6, 9.0	—	—	10.2", 10.1"	—	—
PK 19 +0.1	■	18h 24.1m	-11°07'	—	—	—	5"	—	—
ADS 11318 (Σ2313)	★ ²	18h 24.7m	-6°36'	7.5, 8.8	—	—	6.1"	—	—
Sharpless 2-53	□E	18h 25.2m	-13°13'	—	—	—	15'	—	—
Dolidze 28	○	18h 25.4m	-14°39'	—	—	—	12'	—	20
Lynds 406 (B95)	□D	18h 25.6m	-11°45'	—	—	—	30'	—	—
NGC 6631	○	18h 27.2m	-12°02'	11.7	—	—	5'	—	30
PK 16 -1.1	■	18h 27.9m	-15°33'	—	—	—	11"	2.4 kpc	—
Lynds 435 (B97)	□D	18h 29.1m	-9°56'	—	—	—	50' x 50'	—	—
PK 18 -1.1	■	18h 30.2m	-13°54'	—	—	—	8"	—	—
PK 20 -0.1	■	18h 30.3m	-11°37'	—	—	20.1p	285"	—	—
Lynds 379 (B312)	□D	18h 30.9m	-15°08'	—	—	—	100' x 30'	—	—
Ruprecht 141	○	18h 31.3m	-12°19'	—	—	12p	7'	—	20
IC 1287	□R	18h 31.3m	-10°50'	—	—	5.5	44' x 34'	—	—
Dolidze 29	○	18h 31.4m	-6°38'	—	—	—	18'	—	—
ADS 11414 (Σ2325)	★ ²	18h 31.4m	-10°50'	5.8, 9.1	—	—	12.3"	—	—
Sharpless 2-55	□E	18h 32.2m	-11°46'	—	—	—	20' x 20'	—	—
Lynds 443 (B100-101)	□D	18h 32.7m	-9°08'	—	—	—	40' x 15'	—	—
Dolidze 30	○	18h 32.9m	-6°02'	—	—	—	18'	—	—
PK 21 -0.2	■	18h 33.3m	-10°15'	—	—	20.1p	7"	3.1 kpc	—
NGC 6649	○	18h 33.5m	-10°24'	8.9	—	11.6	6'	1.3 kpc	50
PK 21 -1.1	■	18h 33.5m	-11°07'	—	—	—	10"	—	—
PK 17 -2.1	■	18h 34.0m	-14°52'	—	—	—	6"	—	—
Dolidze 31	○	18h 34.9m	-6°51'	—	—	—	18'	—	—
NGC 6664	○	18h 36.7m	-8°13'	7.8	—	10.2	16'	1.3 kpc	50
Lynds 445 (B314)	□D	18h 37.7m	-9°37'	—	—	—	35' x 25'	—	—
ADS 11512 (B135)	★ ²	18h 38.1m	-14°00'	6.4, 11.2	—	—	2.4"	—	—
Lynds 497 (B103)	□D	18h 39.2m	-6°37'	—	—	—	40' x 40'	—	—
PK 27 +0.1	■	18h 39.4m	-4°20'	—	—	21p	6"	—	—
Trumpler 34	○	18h 39.8m	-8°29'	9.4	—	11.2	8'	—	40
PK 22 -2.1	■	18h 40.3m	-10°40'	—	—	—	8"	—	—
Dolidze 32	○	18h 40.4m	-4°06'	—	—	—	12'	—	40
PK 17 -4.1	■	18h 41.2m	-15°34'	—	—	17.9p	17"	2.6 kpc	—
PK 25 -0.1	■	18h 42.1m	-6°41'	—	—	—	5"	—	—
NGC 6683	○	18h 42.2m	-6°17'	9.5p	—	11.7	11'	1.3 kpc	20
Delta (δ)	★ ²	18h 42.3m	-9°03'	4.7, 12.2	—	—	15.2"	—	—
Trumpler 35	○	18h 42.9m	-4°08'	9.2	—	11.4	9'	1.6: kpc	35
Epsilon (ε)	★ ²	18h 43.5m	-8°17'	5.1, 14.6	—	—	13.6"	—	—
PK 19 -4.1	■	18h 43.6m	-13°44'	—	—	—	13.6"	—	—
PK 22 -3.1	■	18h 44.1m	-11°07'	—	—	—	8"	—	—
M26 (NGC 6694)	○	18h 45.2m	-9°24'	8.0	—	10.3	15'	1.6 kpc	30
PK 19 -5.1	■	18h 45.9m	-14°28'	—	—	—	—	—	—
PK 25 -2.1	■	18h 46.4m	-7°15'	—	—	—	5"	—	—
PK 24 -2.1	■	18h 46.6m	-8°28'	—	—	—	5"	—	—
ADS 11670 (A1887)	★ ²	18h 46.7m	-10°07'	5.7, 13.9	—	—	3.4"	—	—
Lynds 532 (B104)	□D	18h 47.3m	-4°32'	—	—	—	16' x 1'	—	—
R	RV Tau	18h 47.5m	-5°42'	4.5+8.2	—	—	140.1d	—	—
PK 26 -2.1	■	18h 47.5m	-6°54'	—	—	—	7"	—	—
PK 24 -3.1	■	18h 47.8m	-9°09'	—	—	—	6"	—	—
Basel 1	○	18h 48.2m	-5°51'	8.9	—	12.6	9'	1.5 kpc	15
ADS 11695 (Σ2391)	★ ^M	18h 48.7m	-6°00'	6.5, 9.8, 14.3	—	—	37.9", 12.6"	—	—
PK 27 -2.1	■	18h 48.8m	-5°56'	—	—	—	7"	—	—
B108	□D	18h 49.6m	-6°19'	—	—	—	3'	—	—
B318	□D	18h 49.7m	-6°24'	—	—	—	90' x 2'	—	—
Lynds 530 (B110)	□D	18h 50.2m	-4°46'	—	—	—	9'	—	—
ADS 11726 (S)	★ ^M	18h 50.3m	-7°54'	6.8, 11.9, 12.5	—	—	14.3", 44.1"	—	—
NGC 6704	○	18h 50.9m	-5°12'	9.2	—	12.2	6'	1.8 kpc	30
Lynds 534 (B111,119a)	□D	18h 51:	-5°:	—	—	—	120'x120'	—	—
M11 (NGC 6705)	○	18h 51.1m	-6°16'	5.8	—	8.0	14'	1.7 kpc	—
Lynds 548 (B113)	□D	18h 51.4m	-4°19'	—	—	—	11'	—	—
NGC 6712	●	18h 53.1m	-8°42'	8.2	1.2	—	7.2'	7.6 kpc	—
B114-118	□D	18h 53.2m	-7°06'	—	—	—	50'x5'	—	—
PK 27 -3.1	■	18h 53.5m	-6°29'	16.7p	—	21p	35"	—	—
Lynds 509 (B118)	□D	18h 53.9m	-7°27'	—	—	—	1'	—	—
PK 27 -3.2	■	18h 54.0m	-6°26'	13.4p	—	—	—	—	—
PK 24 -5.1	■	18h 54.3m	-10°05'	—	—	—	21"	—	—
IC 1295	■	18h 54.6m	-8°50'	15.0p	—	15:p	86"	1.3 kpc	—
PK 28 -3.1	■	18h 57.8m	-5°28"	—	—	—	8"	—	—

earlier by John Hevelius.

However, on the evening of Sept. 1st, 1681 I observed another nebulous star, which, as far as I know, no one has observed before, close to the northern foot of Ganymede. Its shape was not unlike that of the comet which I found in the telescope at 0 degrees $\mathfrak{M}$ on the morning of Nov. 4th, 1680, and therefore I was at first uncertain whether the phenomenon was a comet or a nebulous star. When, for successive days its form and position remained unchanged it was easy to decide that it was not a comet but most certainly a nebulous star.

Whether it will always be thought truly stellar or whether, on the other hand, it will appear more like the Andromeda Nebula, experience will tell.

This star is not easily visible to the naked eye; however, in a 13-foot [focal length] telescope, it can be seen as shown at A in the adjoining diagram. Its place among the stars, such as it would be seen in a 4-foot telescope, is shown at B. The stars g, h, λ in the left foot of Ganymede (called the right foot in the Rudolphine Tables) are lettered in Bayer's Uranometria. The stars a, b, c represent those shown in Uranometria, but not lettered, near the foot situated in the Milky Way. These six stars are very easily visible to the naked eye; however, the other four stars d, f, e, i, and the nebulous [one], indicated by the letter N and the faint k which is close to it, are visible only in the telescope.

So reads the discovery announcement of M11, stuck in an appendix of the 1682 Leipzig Ephemerides. Kirch would probably be happy to know that indeed astronomers still regard M11 as starry rather than nebulous like the "Andromeda Nebula." What did other well-known observers of the past think of M11? One such observer who left ample records of his observations of M11 was Admiral William Henry Smyth, who wrote about the cluster in his book *A Cycle of Celestial Objects*, published in 1844. Smyth's description, which needs help with punctuation but includes the remark that led to the nickname "Wild Duck Cluster," reads:

[M11 is] a splendid cluster of stars, closely to the east-south-east of the above described object [a double star]; it precedes the left foot of Antinous, and is on the dexter chief of Sobieski's shield. This object, which somewhat resembles a flight of wild ducks in shape, is a gathering of minute stars, with a prominent 8th-magnitude in the middle, and two following; but by all analogy these are decidedly between us and the cluster. This, however, was not the opinion of Kirch, its discoverer, who, in 1681, described it as a small obscure spot, with a star shining through, and rendering it more luminous. Dr. [William] Derham first resolved it into stars, with his 8-foot reflector, as shown in the

Philosophical Transactions for 1733. "It is not," said he, "a nebulae, but a cluster of stars, somewhat like that which is in the Milky Way." That in the Milky Way!

This fine object is on the shield by which Hevelius intended, FOR EVER, to honour the name of John III., king of Poland. In the Prodomus Astronomiae, he appears to be uncommonly elated on having raised it to the perpetual memory of the glorious liberator of Vienna — 'ob immensa ejus merita, heroicas animi dotes, magnanimitatem, et ob res strenue, ac fortiter gestas.' He was delighted in being able to place it in the happiest part of the firmament, where all the members and neighbors are significant. 'I wish you to know, benevolent reader,' he says, 'that this shield consists of seven lucid stars, partly of the 4th magnitude; four of these are placed in the border of this shield, and designate the princes of our serene king, who at that time were all among the living. In the middle of the shield I have designed a cross, in eternal remembrance of the battles most happily fought by him for the Christian faith: three notable stars shine in this cross, of which one indicates his own royal person, another the queen's, and a third the princess's, his only daughter; so that these seven stars represent the whole reigning family.' This, and much more, shows his anxiety and hope of its eternal duration; but, poor fellow, Mr. Baily has taken the field, and Sobieski is one of the first among the asterisms recently doomed to proscription. I hope this pruning-knife is to be applied to many other interlopers, most of whom are far more petty than this.

The last part of Smyth's description includes a quotation from Hevelius, which amounts to a bizarre description of the origin and state of "Sobieski's shield" in the mid-nineteenth century.

Observationally M11 is difficult to describe, but it could perhaps best be called a very rich, large open cluster composed of several hundred members arranged in a triangular pattern with one bright star slightly off-center. A large telescope clearly shows this star is orange. With a small telescope M11 appears as a fan-shaped smear of light with a few bright stars peppered throughout. A 10-inch or 12-inch scope shows many dozens of members and demonstrates why Admiral Smyth called the group the "Wild Duck" cluster. M11's total magnitude is 5.8, which makes it visible to the naked eye under a dark sky.

Barnard 112 is a dark nebula located just south of M11. Visible in an 8-inch scope at low power, this lane of dark nebulosity is 20' long and ends in a starless spot about 10' across. With a 17.5-inch scope you can follow this nebula from near the edge of M11 into the nearby Milky Way.

NGC 6712 is a pretty, bright globular cluster that would be much more

impressive if it weren't behind the Milky Way. A very rich, compressed cluster, NGC 6712 glows at magnitude 8.2 and measures 7.2' across. The cluster appears elongated at high power; a 17.5-inch scope shows about fifty stars resolved over a bright condensed center and a smooth, outer halo of nebulosity. In Australia a 12.5-inch scope does just about as well.

Frequently mislabeled as IC 1298 (*Sky Atlas 2000.0*, Burnham's *Celestial Handbook*), planetary nebula **IC 1295** is a challenge even for large telescopes. Its position is easy to locate, because this nebula lies about 40' east-southeast of NGC 6712. However, this ring-shaped object has a photographic magnitude of 15.0 and measures 86" across, which make its surface brightness pitifully low. An 8-inch scope only shows this object on extremely good nights. A 12.5-inch scope, on the other hand, shows IC 1295 with averted vision as a pale disk of nebulosity with a star involved. Adding a UHC filter to the optical path brought out the nebulosity and made it visible with direct vision. A 17.5-inch scope with a UHC filter shows IC 1295 as a comet-shaped nebulosity with three faint stars involved.

Basel 1 is an open cluster located northwest of M11 in the trapezium of stars that includes R Scuti. In an 8-inch scope at 80x, all four of these stars lie at the edge of the field of view. Basel 1 is a scattered cluster of eight stars that shine around 12th magnitude. A 17.5-inch scope reveals several parallel chains of stars set against a hazy background.

Like any Milky Way constellation, Scutum contains some interesting stars. **Delta (δ) Scuti** is the brightest double star in Scutum. In 8-inch and 17.5-inch scopes we saw the primary (magnitude 4.7) as pale yellow. The triple star **ADS 11282** is easy to split in any scope; the two brightest stars show yellow and blue in an 8-inch scope and copper and cobalt blue in a 17.5-inch telescope. **ADS 11414**, another easy pair, shows a yellow primary and bluish secondary in any telescope. **ADS 11695** is an attractive triple star with white and blue components in the field of cluster Basel 1.

Scutum is proof that if you spent all your observing time in large, bright constellations, you would miss some first-class deep-sky objects. The table on page 18 lists many more than those discussed here, as does Alister Ling's discussion of the star cloud (see sidebar). We invite observers to view all the objects mentioned here and to let us know what you see. A special challenge to astrophotographers: Plot some of the many faint Scutum planetaries on *Sky Atlas 2000.0* and try to photograph them; many of them have yet to be photographed by amateurs!

Fifty-to-the-Pole: The Observing Project of a Lifetime

by Lucian J. Kemble

During the peaceful territorial disputes between Canada and the United States in the last century, the slogan "Fifty-four-forty or fight!" was used by both sides when arguing Alaska/Canada latitude claims. The incident came to mind as I sought a slogan for my current observing project and settled on "Fifty-to-the-Pole." My goal is to observe and draw all the deep-sky objects within my telescopic limit from an arbitrary declination of $+50^\circ$ to the north celestial pole. At my latitude of $51^\circ 12'$ north, this zone is circumpolar and comfortably above my northern horizon all year. For the time being "deep-sky objects" refers only to galaxies, open and globular clusters, planetaries, and bright nebulae, not to variable and double stars.

I came to this project in a roundabout way. About ten years ago I began to sketch a few deep-sky objects with my first telescope, a Celestron 5. Then I purchased an 8-inch telescope and began systematically sketching all the objects in the Messier catalogue. The experience was so enriching I began to look for other lists. My good Florida friends, Brenda and Dave Branchett, put me onto their newly compiled and published list of the four hundred best Herschel objects. I completed this project by October 1981 and gained precious experience and skill in observing and drawing. Still I longed for more.

And I found more. I made drawings of the objects in *Norton's Sky Atlas*, the Royal Astronomical Society of Canada's *Observer's Handbook*, Vehrenberg's *Atlas of Deep-Sky Splendors*, the monthly *ASTRONOMY* and *Sky & Telescope* listings, many in Burnham's three-volume *Celestial Handbook*, the lists in *Deep Sky*, and, of course, the *Revised New General Catalogue of Nonstellar Astronomical Objects*. A permanently installed C11 on a Byers mount has increased my number of observations enormously during the past five years.

A year or so ago I came to the surprising realization that I had sorely neglected the circumpolar sky except for a few Messier objects and some bright open clusters. The reasons for this were many. First, this region is there year-round. "I'll come back to it some day; in the meantime there are those interesting southern-declination objects that pass up and down so swiftly!" Then there are all those wonderful fields of winter and summer Milky Way wonders to explore. And what about those seemingly endless, unexplored, galaxy-rich skies of the Virgo-Coma-Ursa Major regions? (See "Plotting the RNGC, Part 2," by Richard Berry, *Deep Sky*, Spring 1986). Besides, there are some rather weird complications in zenith-to-pole observing and confusing east-west apparent reversals when you face north below the pole.

Realizing I had neglected the northern circumpolar region, I formulated Fifty-to-the-Pole. I began by listing systematically, hour zone by hour zone and from $+50^\circ$ northward, all the objects in the RNGC and other sources not already covered (such as those plotted on Tirion's *Sky Atlas 2000.0* and other star charts) of 15.5 magnitude or brighter. Equipped with these lists, I began my project of observing and drawing. To date I have done over 40 percent of the six hundred or so deep-sky objects within the reach of my 11-inch scope. This includes all objects brighter than magnitude 13 and over one hundred objects between magnitudes 13 and 15.5. The 60 percent remainder is almost overwhelmingly comprised of RNGC galaxies fainter than magnitude 13, and therein lies the challenge.

The difficulties come from several sources. Plots of these objects, such as Berry's plot and my own, reveal that most of the faint galaxies lie in two main zones, peaking at 11h and 17h. These zones coincide with either cold winter-

to-spring observing or late northern summer twilight. Toss in vagaries of monthly Full Moon, occasional sky fog, and other hazards, and you can see the difficulties of observing magnitude 14 and 15 galaxies.

I would like to present my plot of all these objects and a sample list of my favorite objects, most of which are within reach of an 8-inch scope in a dark sky.

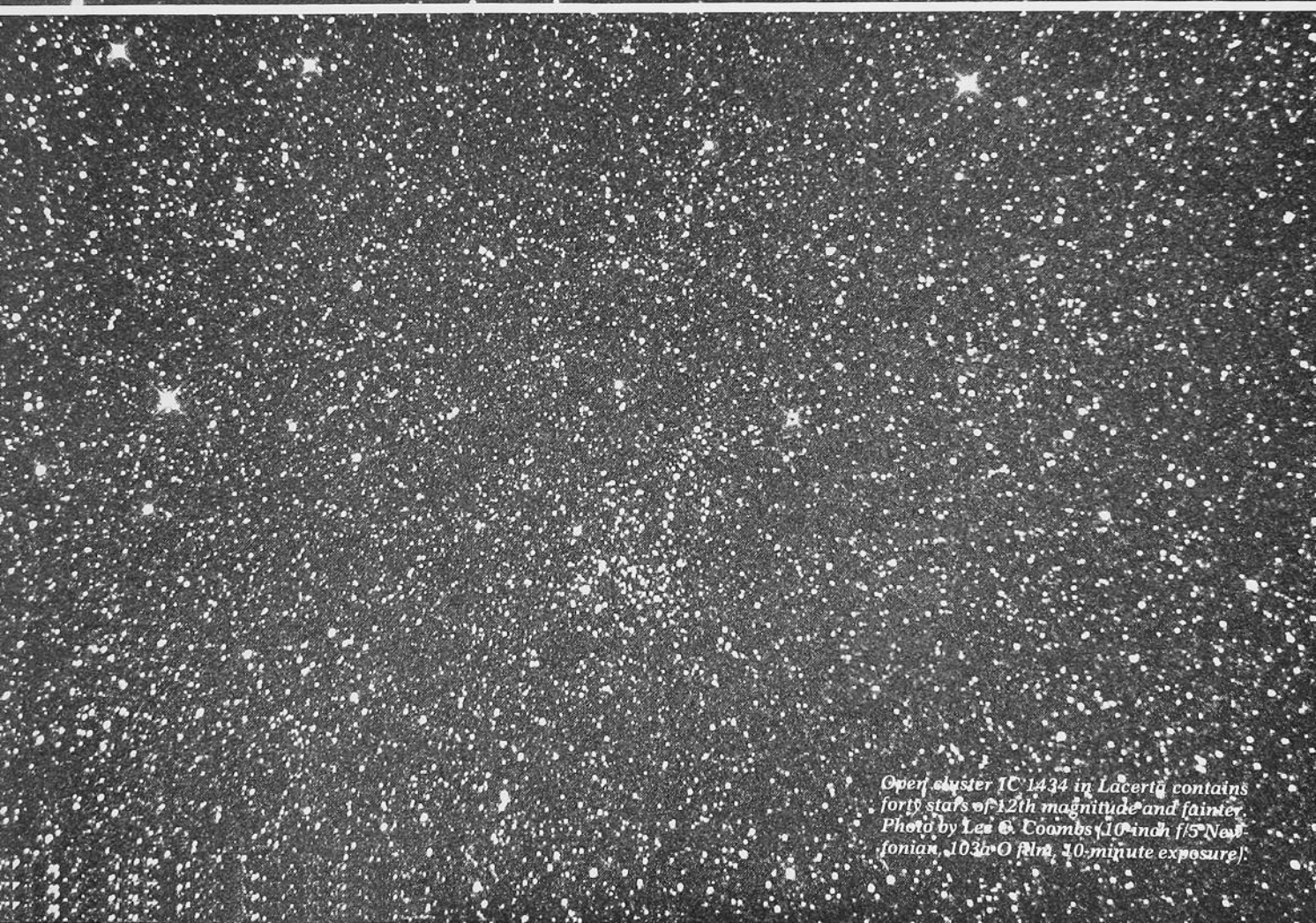
In the letters column (Fall 1986) a fellow Albertan revealed his disappointment with the "additions of marathons" to amateur astronomy, such as a Messier marathon in which observers try to see all or nearly all of the Messier objects in one night. I suppose such marathons can be fun, but I have found that applying myself to a well-prepared, systematic observing program is extremely rewarding. Such a program is a challenge and a test of your observing skills that yields unexpected, pleasant surprises, some frustration, and plenty of insight into the universe.

A project like Fifty-to-the-Pole requires more than casual roaming among bright objects. I also suggest delving into those marvelous lists to be found in every issue of *Deep Sky*, which show data on obscure, non-RNGC clusters, or a marvelous source called *The Revised Shapley-Ames Catalogue of Bright Galaxies*. The Royal Astronomical Society of Canada *Observer's Handbook* and the up-to-date listings in the annual *Astronomical Almanac* are also very helpful.

When you plot deep-sky objects, you can see some interesting things, like the preponderance of clusters and planetaries in the area stretching from northern Cygnus to northern Perseus. This so-called "zone of avoidance" also explains the absence of galaxies, because dust in the galactic disk blocks galaxies from shining through. Galaxy populations are highest through the Ursa Major and Draco regions. The only Messier objects



Low surface brightness galaxy IC 342 is a tough northern object. Photo by Martin C. Germano (8-inch f/5 Newtonian, hypersensitized Tech. Pan, 45-minute exposure).



Open cluster IC 1434 in Lacerta contains forty stars of 12th magnitude and fainter. Photo by Lee G. Coombs (10-inch f/5 Newtonian, 103b-O film, 10-minute exposure).

25 SELECT OBJECTS — "Fifty-to-the-Pole"

Object	Type	R.A. (2000)	Dec.	Const.	Diam.	N*	Mag.	Notes
NGC 188	⊙	0h44.4m	+85°20'	Cep	5'	25	10.6	
Tr 1	⊙	1h35.7m	+61°17'	Cas	4.5'	20	8.1	
IC 1851	□E	2h51.7m	+58°18'	Cas	—	(Nebulosity surr. 6.45m Star SAO 23662)		
IC 342	§B	3h46.8m	+68°06'	Cam	11.8' x 17.4'	—	9.1	S(B)c
NGC 1502	⊙	4h07.7m	+62°20'	Cam	8	45	5.7	
NGC 1961	§	5h42.1m	+69°23'	Cam	4.3' x 3.0'	—	11.1	Sb pec
NGC 2146	§B	6h18.7m	+78°21'	Cam	6.0' x 3.8'	—	10.5	SBb pec
NGC 2320	eg	7h05.6m	+50°36'	Lyn	—	—	14.0	
NGC 2322	eg	7h05.9m	+50°31'	Lyn	—	—	14.5	
NGC 2602	eg	8h35.1m	+52°50'	Lyn	—	—	15.5	
NGC 2603	eg	8h35.5m	+52°47'	Lyn	—	—	15.0	
NGC 2606	eg	8h35.7m	+52°48'	Lyn	—	—	15.0	
NGC 2715	§	9h08.1m	+78°03'	Cam	5.0' x 1.9'	—	11.4	Sc
NGC 3183	§	10h21.8m	+74°10'	Dra	2.5' x 1.6'	—	12.7	
NGC 3172	§	11h50.2m	+89°07'	Umi	0.7' x 0.7'	—	13.6	
NGC 3972	§	11h55.8m	+55°19'	Uma	4.0' x 1.3'	—	13.0	Sb
NGC 4157	§	12h11.1m	+50°29'	Uma	6.9' x 1.7'	—	11.7	Sb
NGC 5308	§L	13h47.0m	+60°58'	UMa	3.5' x 0.8'	—	11.3	S0
NGC 5484	∅	14h06.8m	+55°02'	UMa	—	—	15.5	E2
NGC 5485	§	14h07.2m	+55°00'	UMa	2.6' x 2.1'	—	12.4	Sa
NGC 5486	§	14h07.4m	+55°06'	UMa	1.7' x 1.1'	—	13.9	Sm
NGC 5909	eg	15h11.5m	+75°08'	UMi	—	—	14.5	
NGC 5912	eg	15h11.7m	+75°08'	UMi	—	—	14.5	
NGC 6251	eg	16h32.6m	+82°33'	UMi	—	—	14.0	
NGC 6252	eg	16h32.6m	+82°36'	UMi	—	—	14.0	
NGC 6543	■	17h58.6m	+66°38'	Dra	18"	—	8.8	
NGC 6654	§B	18h24.1m	+73°11'	Dra	3.0' x 2.4'	—	11.6	SBa
NGC 6826	■	19h44.8m	+50°31'	Cyg	30"	—	9.8	"Blinking Planetary"
NGC 6939	⊙	20h31.4m	+60°38'	Cep	8'	80	7.8	
NGC 7023	□R	21h01.8m	+68°12'	Cep	18'	—	6.8	
IC 1434	⊙	22h10.5m	+52°50'	Lac	8'	40	9.0	
NGC 7510	⊙	23h11.5m	+60°34'	Cep	4'	60	7.9	

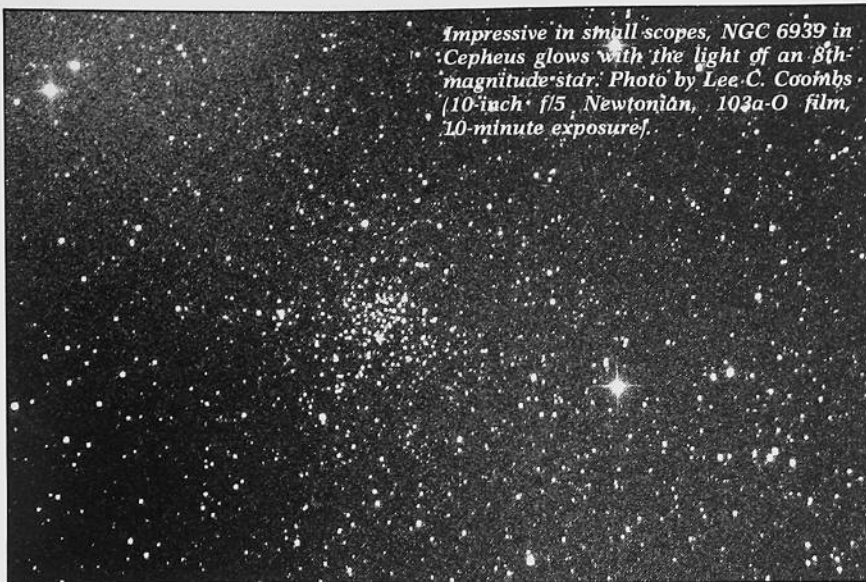
⊙ = Open star cluster
 ■ = Planetary nebula
 □E = Emission nebula

□R = Reflection nebula
 eg = Galaxy
 § = Spiral galaxy

§B = Barred spiral galaxy
 §L = Lenticular galaxy
 ∅ = Elliptical galaxy



One of the sky's brightest reflection nebulae is NGC 7023 in Cepheus. Photo by Martin C. Germano (8-inch f/5 Newtonian, 103a-F film, 35-minute exposure).



in this region are M40, M52, M76, M81, M97, M101, M102, M103, M108, and M109.

Fifty-to-the-Pole: Select Objects

NGC 188. This large open cluster is bounded on the east and south by brighter stars. NGC 188 is one of the oldest known galactic clusters.

Trumpler 1. At low power this charming cluster appears as a tiny, box-like group of stars in a rich starfield.

IC 1851. Compare this nebula with NGC 7023. Each appears as a nebulous glow around a bright star. This object is best seen with a UHC filter.

IC 342. A small barred spiral with a bright core; in small telescopes IC 342 resembles a planetary nebula.

NGC 1502. This bright cluster contains many double stars. It lies at the base of a chain of faint stars.

NGC 1961. Recognized as one of the largest galaxies, NGC 1961 has a small nucleus and a low surface brightness that makes spotting it a challenge.

NGC 2146. Classified as a peculiar barred spiral, this galaxy appears clearly elongated in small scopes. It lies west of a neat little group of faint stars.

NGC 2320 and NGC 2322. I spotted NGC 2320 easily in spite of interference from a bright auroral band. There is a strange difference in the old and new descriptions in the *RNGC* for NGC 2320. The old description states that an 8th-magnitude star lies to the southwest, but the new description states (more correctly) that a bright star lies 1' to the northeast. NGC 2322 is faint and lies to the southeast in the same low-power field.

NGC 2602, NGC 2603, and NGC 2606. These three 15th-magnitude gal-

axies are a real challenge and require dark skies and great patience. I've found they won't be visible through sweeping but by careful use of accurate setting circles.

NGC 2715. This is a large faint elongated spiral located in a nice starfield.

NGC 3183. A large, oval galaxy, NGC 3183 is mottled with four or five faint, starlike points.

NGC 3172. Known as Polaris Borealis, NGC 3172 is the most northerly placed bright galaxy. It has a small, faint, starlike nucleus when viewed with averted vision. The coordinates of NGC 3172 change rapidly because of the effects of precession.

NGC 3972. This spiral revealed itself as an elongated glow only after long, persistent observation.

NGC 4157. This faint, elongated spiral is nicely nestled in a field of fairly bright stars.

NGC 5308. With an almost starlike core this lenticular galaxy is quite bright and easy to find.

NGC 5484, NGC 5485, and NGC 5486. An especially satisfying group of galaxies. NGC 5486 is extremely faint and listed at magnitude 15.5.

NGC 5909 and NGC 5912. This is a fine pair of galaxies, both magnitude 14.5 objects, located in the cup of Ursa Minor just northeast of Beta (β) Ursae Minoris.

NGC 6251 and NGC 6252. These two objects form a nice galaxy pair. NGC 6252 is the first 15th-magnitude galaxy I ever observed; I caught it just as the Moon was rising.

NGC 6543. One of the finest planetaries in the circumpolar region is NGC 6543. Easy to find, this planetary nebula appears sharp and contrasty with a greenish hue. NGC 6552, a 14th-magnitude galaxy, lies to the southeast.

NGC 6654. A barred spiral, NGC 6654 is easy to identify, appearing round and reasonably bright.

NGC 6826. The famous Blinking Planetary looks like a bluish star when viewed with direct vision. But the whole nebula pops into view when you use averted vision. This object lies east of the double star 16 Cygni. Both can be viewed within same low-power field.

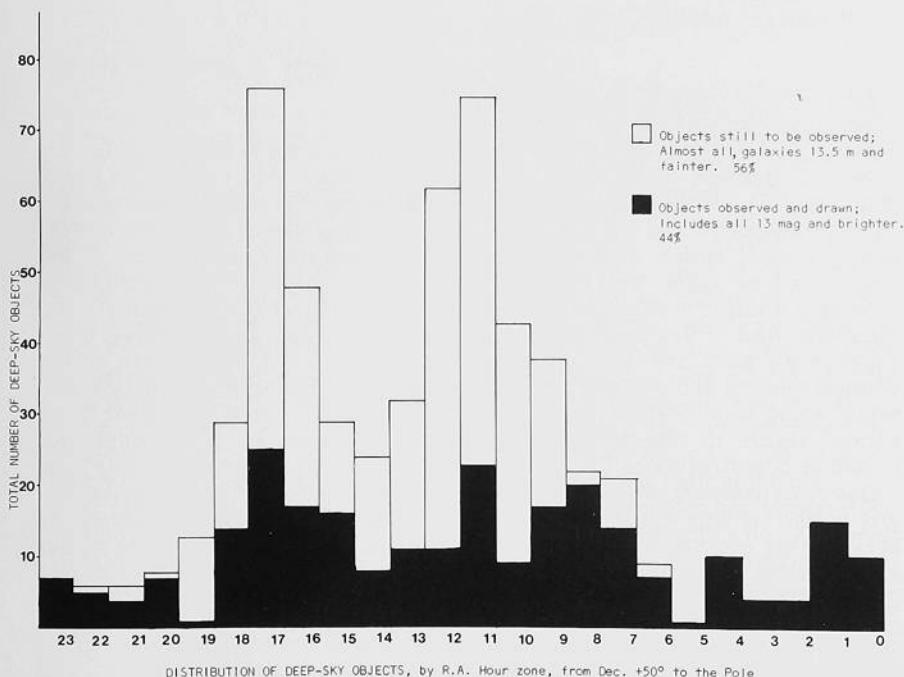
NGC 6939. This is a tight little cluster of faint stars.

NGC 7023. Comparable to IC 1851, this reflection nebula is a gem. The nebulosity is best seen without a nebula filter, because it is reflected light.

IC 1434. This is a nice cluster with many faint stars in two "arms."

NGC 7510. Appearing like a swarm of glowing gnats flying in a V-formation, NGC 7510 is a gorgeous cluster set off in a sea of black space.

I hope that these objects, some of the best and brightest in the northern circumpolar sky, give you many hours of interesting observing.



DISTRIBUTION OF DEEP-SKY OBJECTS, by R.A. Hour zone, from Dec. +50° to the Pole

Learning to See

by James E. Meketa

Almost everyone can remember being taught to read, but almost no one remembers being taught to see. And yet a sizable portion of every person's childhood is made up of seeing lessons. Our parents begin educating us at birth by catching our attention, presenting familiar shapes and faces, and rewarding us when we recognize them. By the time he's one year old, the average child has already been taught to make routine visual discriminations that are orders of magnitude better than what we can achieve with our best computerized robots like the *Viking* landers.

While our ability to see depends upon physical organs such as the eye, seeing is better understood as a *learned skill*. And like any skill, seeing can be refined, practiced, and perfected. William Herschel, perhaps the greatest visual observer of all time, recognized the importance of practice in seeing when he commented: "Seeing is in some respect, an art which must be learnt. Many a night I have been practicing to see, and it would be strange if one did not acquire a certain dexterity by such constant practice." Seeing is a deep skill, one we learn in parts of our brains that are not generally accessible to conscious thought. The process of seeing feels automatic, almost like breathing, which is why improving their seeing skills does not occur to most people.

My high school biology teacher tried to show the class how we could learn to see better by explaining the difference, in his words, between "seeing" and "observing." Seeing was just looking at things, but observing was really studying, looking hard for details and patterns. He pointed out that when we casually look, we miss many important details, but he made observing sound like work. Actually seeing is fun, and learning to see better should be even more fun, not work. Fortunately, teaching yourself to become a better observer is easy. With a little practice most people can teach themselves to see details in clusters and nebulae that they had believed would require a much larger telescope to detect at all.

To teach yourself to see better, you must first look through the eyepiece more consciously and less automatically. This means you must make a point, as you examine a deep-sky object, of looking for certain details and fea-

tures *every time*. In his excellent book *Messier's Nebulae and Star Clusters*, Kenneth Glyn Jones offers the following list of self-examination questions to use at the eyepiece as you observe:

- i. Is [the deep-sky object] round, or oval, or spindle-shaped, or what?
- ii. If not round, in which direction is it elongated?
- iii. Is it brighter or less bright in the center?
- iv. Is the brightness gradient gradual or abrupt?
- v. Are there any dark markings?
- vi. Are there any starlike points of light involved?

"Seeing is in some respect, an art which must be learnt. Many a night I have been practicing to see, and it would be strange if one did not acquire a certain dexterity by such constant practice."

— William Herschel

- vii. Is there any trace of an outer ring?
- viii. What are its dimensions? (Compare known size.)
- ix. What is its magnitude? (Compare known magnitude.)
- x. Does it resemble any other known object?

After a while you will find that this simple conscious effort has become automatic. Your seeing will be improved, perhaps dramatically, but don't make the mistake of believing you have learned all there is to know about seeing. Instead, simply make the process conscious again, but this time expand and refine your list of mental questions. And, if you have the same experience I have had, you will find yourself amazed and delighted as you begin seeing subtle details you never noticed before in objects you have looked at dozens of times.

Observing planetary nebulae is a good way to start refining your seeing skills, because they come in a wide range of sizes, shapes, and colors. *Burnham's Celestial Handbook* lists 92 bright planetaries north of -40° declination, and perhaps another 250 are visible in large amateur telescopes in the northern

hemisphere. As I look at planetaries I ask myself the following questions:

- How large is this planetary in arcseconds or arcminutes?
- What is its basic shape? Is it round like M97, oval like M57, irregular like M76, or does it appear stellar?
- Is the nebulosity even and featureless, or are there internal details?
- Are the edges even all the way around, or are some parts more ragged than others?
- Does the nebula look annular or ring-shaped? Is there any trace of faint nebulosity *outside* the main object?
- How bright is the nebula as a whole? Can I estimate its magnitude compared with nearby field stars?
- How does the brightness change, if at all, from part to part?
- What color is the nebulosity? For example, to me the Saturn Nebula (NGC 7009) appears as a vivid fluorescent green, while other planetaries may be white, gray, beige, blue, or even yellowish.
- Can I see its central star, and if so, how bright is it? Does the appearance of the central star change depending upon whether I use direct or averted vision?
- Are other stars visible within the nebula? Do any of the stars show any color?
- What does the surrounding background starfield look like?
- Does the planetary's appearance change at high powers? What power seems to give me the best detail?
- What does the object remind me of? A snowball? A smoke ring? Another planetary?

You may want to make a similar list for each major type of deep-sky object you observe. For helpful ideas, read the descriptions offered by other observers in this magazine and in some of the standard reference books. Then select a familiar object and look at it as carefully as you can. Without direct reference to your list, write down all the details and impressions of what you see. Then go back to your list and see if you have answered all of the questions. When you reach the point where your lists never surprise you and never contain a question you cannot answer, you will discover that your ability to see has improved many fold. And the best part is that improving that ability is much cheaper than buying a bigger telescope!

1029 Beacon Street
Newton Centre, MA 02159

The Value of Drawing Deep-Sky Objects

by Gregg Thompson

Many amateurs find deep-sky observing challenging, especially when they realize these remote objects are being viewed as they were hundreds, thousands, or even millions of years ago. To know you have actually seen these distant places in our universe with your own eyes gives you a grand feeling of achievement.

However, after you look at many objects, it becomes difficult to remember exactly what any particular object looks like. Our memories of objects of a similar nature tend to blur into one another with time. So, instead of just looking at deep-sky objects, increasing numbers of amateurs are finding it useful and pleasing to record their observations for all time, so they can look back or compare with others what they have seen during previous observing sessions.

Most amateurs first try making written descriptions of what they see, but these descriptions fail to do justice to the exquisite detail visible in the eyepiece. No matter how detailed the description is, it seldom gives an accurate picture of the subtle variations in brightness, shape, and color of the object and its surrounding starfield.

A good way to illustrate this is to try the following test on yourself and your deep-sky observing friends. Read the descriptions of a few objects you are not familiar with from any or all of the books you have that describe the appearances of these objects. From the descriptions try to sketch what the objects should look like in the telescope. You will be amazed at how often the information is so vague you cannot even commence the sketch, let alone make it appear just as it would in a telescope.

You will also note that there are often considerable differences or even contradictions about an object's appearance from one source to another. If you do attempt to make a sketch from the description, see how much your sketch resembles the real appearance of the object and its field by comparing your sketch to a photograph of the object or its visual appearance in your telescope. If you do this test with others, you will invariably find that each person will perceive the verbal description in quite a different way. And no one will have a clear idea of what the object or the surrounding field looks like.

Another interesting exercise is to choose descriptions of similar types of objects and see if the written descriptions reveal how different the objects are in reality. Even clusters of the same

class, brightness, and dimension look different from one another visually, but in words it is difficult to distinguish between them.

Rather than making notes on the appearance of deep-sky objects, try making accurate sketches and supplement the sketch with a few notes when necessary. With a little practice you will probably become quite adept at recording exactly what various objects look like. You will find that the act of drawing an object accurately forces you to be far more discerning and therefore more likely to detect detail that is generally overlooked in a verbal description of the object. A good drawing at the telescope is the best means of recording the appearance of any object as it is seen visually.

Drawings have some advantages over photography, even though drawings do not provide the positional accuracy that can only be obtained from high-resolution photographs that are not overexposed.

Photographs of compressed clusters frequently overexpose so much that the configuration of the stars at the center is lost. Furthermore, photographic images of the stars are usually much larger than the stars appear visually because of diffusion of the starlight in the emulsion and movement of the image caused by seeing. Drawings do not suffer from such problems.

Drawings can often be the most effective means of recording detail in small objects that amateur astronomers and even professionals have difficulty photographing. Small objects require high magnification to reveal detail. In photography this means a large aperture,

long exposures, and very accurate tracking — a tall order! High magnifications can be used visually to great advantage with medium to large amateur sized telescopes and surprisingly detailed drawings can be obtained with ease.

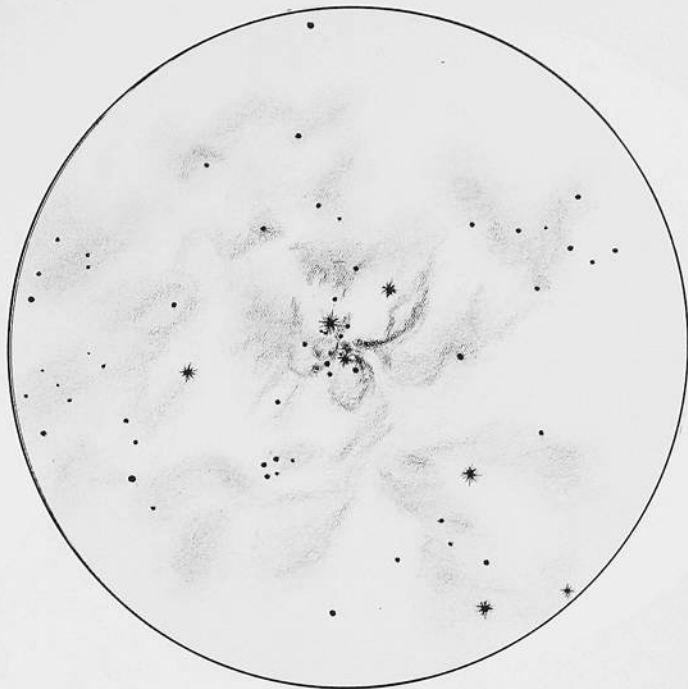
To capture the faint extensions of a nebula, photographs usually have to overexpose the brighter regions. Subtle detail, if not all detail, is lost in the bright regions of many gaseous nebulae and galaxies, and the central regions of most rich globulars are completely burned out when recording the faint detail. The eye, however, does not suffer so acutely from overexposure, so drawings can record detail in bright regions as well as in faint sections.

Although stars that are immersed in bright nebulae are usually easy to see visually, they are invariably very difficult to record photographically. Of course, multiple exposures or unsharp masking techniques can help overcome this problem, but this is seldom done. Once again, drawings of stars immersed in bright nebulae will often prove superior in this respect to photographs.

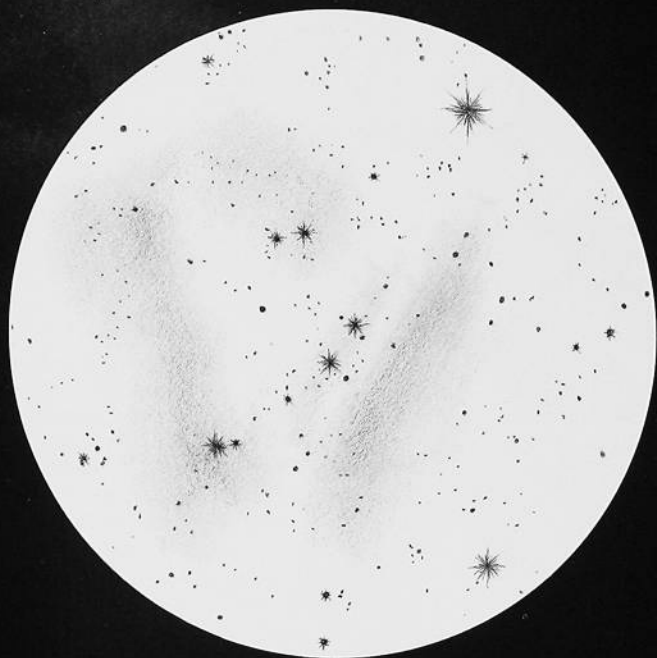
Good drawings are much faster and cheaper to make than a good photograph. This doesn't mean drawings should replace photography; rather, drawings complement photography.

Even the most seasoned observers continue to learn new skills and information from this enjoyable form of observing. All you need is interest, a little patience, practical instrumentation, and sympathetic weather.

Springwood Observatory
7 Stroker Court
Springwood,
Queensland, Australia 4127



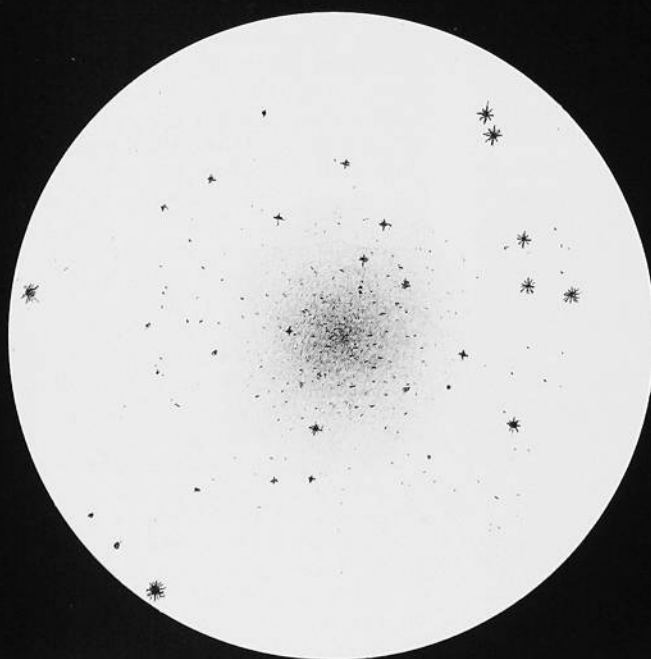
The Tarantula Nebula, NGC 2070, offers a complex network of nebulosity to those who sketch deep-sky objects. This 12-inch f/5 rendering at 250x and the remaining sketches in this article are by Gregg Thompson.



Large, faint nebulosities like IC 2948 in Centaurus require placing the stars first and then carefully and accurately laying down graphite and shaping it by smearing to resemble the object's visual appearance. This sketch was made with a 16.5-inch f/4.3 Newtonian at 54x and an OIII nebular filter.



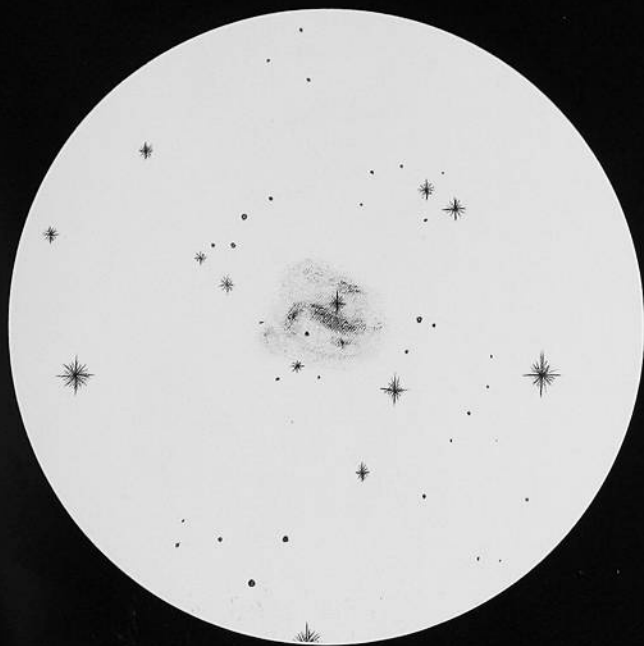
The procedure for sketching galaxies can be tricky, especially if the object in question shows minute details. The best way is to plot the stars, lay some graphite for the galaxy's nucleus, and smear it carefully to simulate the arms or halo. Next touch up the nucleus to give it the correct relative brightness and use an eraser if necessary to shape the galaxy's halo. Finally add the detail (like these knotty patches in Carina's NGC 3590) to finish the sketch. This rendering was made with a 12-inch f/5 telescope at 330x.



Because of the sheer number of stars, it's nearly impossible to sketch each and every member of a globular star cluster. The key is to draw the field stars and prominent cluster stars accurately, simulate the cluster's glow from unresolved stars by smearing graphite, and approximate the density and placement of cluster members by dotting the glow with a sharp pencil. This sketch of NGC 2808 in Carina was made with an 8-inch f/10 SCT at 154x.



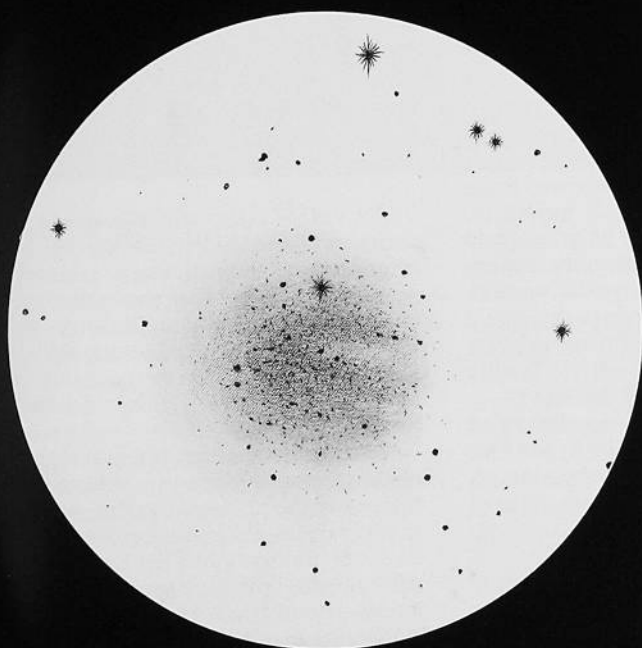
Getting the shapes of planetary nebulae just right is important. NGC 3211 in Carina is very slightly ovoid and has an almost imperceptibly brighter half-ring of material between its edge and center. Sketching detail like this makes an object "come alive" on paper. This rendering was made with a 12-inch f/5 telescope at 660x.



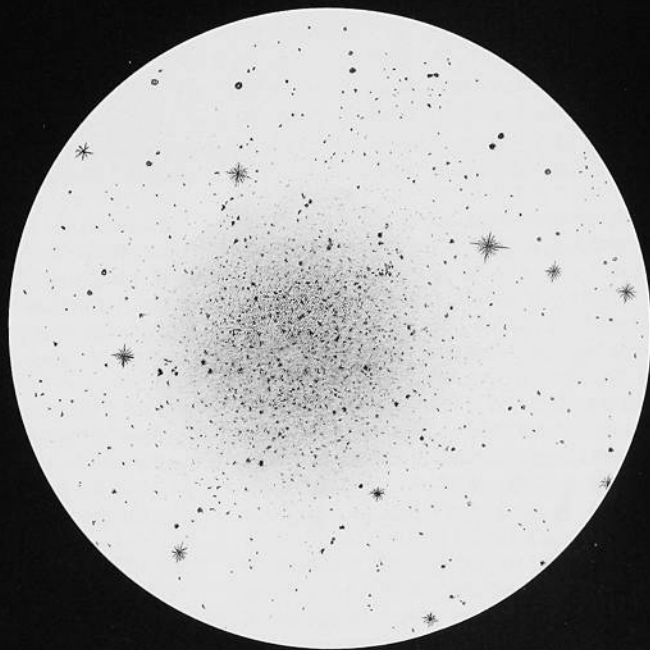
Sketching techniques aren't necessarily married to object type. The unusually large and bright planetary nebula NGC 5189 in Musca resembles a face-on barred spiral galaxy, so drawing it requires the same touch you would use on M61 or M83. This sketch was made with a 12-inch f/5 telescope at 330x and an OIII nebular filter.



Large, faint, and wispy, the group of emission nebulae in Carina designated NGC 3576, NGC 3579, NGC 3581, NGC 3582, and NGC 3584 actually provide easy sketch material, because the nebulosity lacks detail. All that must be done is essentially star and nebula placement. This sketch was made with a 12-inch f/5 telescope at 330x.



Musca's brightest globular cluster, NGC 4833, has a prominent dark lane extending from its eastern edge clear through to the cluster's center. This sketch was made with an 8-inch f/10 SCT at 155x.



NGC 5139, better known as Omega (ω) Centauri, is one of the most difficult objects in the sky to sketch with a large telescope. Thousands of stellar points crowd the field, and their placement relative to the cluster glow and field stars makes or breaks the drawing. Such sketches require an investment of several hours at the eyepiece. This sketch was made with a 12-inch f/5 telescope at 119x.

Reflections on Surveying the Heavens

by Patrick W. Drigans

When you look upward into the sky on a clear dark night, you witness the vastness and unsurpassed beauty of the heavens. Starlight attracts human attention outward through the splendor of observing the countless variety of objects and also inward through reflection and awareness of the significance of these visions. Amateur astronomy is indeed among the most sublime of hobbies.

The magnitude of some observing projects is astounding. When I first heard of amateur astronomers surveying all 7,800 objects in the *New General Catalogue*, for example, I laughed. Who would seriously think of doing such a thing?

Although such a project would be a colossal undertaking, it certainly could be done. William Herschel didn't have high-tech equipment, yet today his accomplishments remain unsurpassed by modern day observers. The key is a positive attitude. Herschel loved the heavens and with that love he learned to develop skills and resources that sharpened his abilities. I used to think that only those with large aperture telescopes could undertake a project such as observing the entire *NGC*. But I hadn't yet developed the patience necessary to view faint objects with my 10-inch telescope. It took a long time to realize that even though I observed primarily from the light-polluted skies of suburban Minneapolis, I too could make a systematic survey of the heavens.

Clearly it would take many years to complete such a project. But there are two reasons amateurs may want to try. First, the universe is beautiful. To see it one object at a time not only allows you to see a wide variety of deep-sky objects over time but also enriches your understanding of the grand scheme of things. Second, you'll learn a multitude of observing skills. You'll need the patience to wait for many dark, clear nights and the perseverance to track down objects in an intentional fashion. But if you do this, you'll get a sense of accomplishment and fulfillment.

This article does not address any specific system for searching the sky. The strategy for conducting the search is left to the reader. Rather, I want to discuss how to develop the tools necessary for making any survey successful. Conducting a systematic search of the heavens involves three activities:

- Surveying and studying catalogues, literature, and atlases.

- Careful observing at the eyepiece.
- Keeping records and reflecting upon the observations.

Studying catalogues means doing your homework before you observe. The most expedient way to conduct a night's observing is to thoroughly research the regions of sky you wish to observe before you get out under the stars. Today there is a greater quantity of high-quality information available on deep-sky objects than ever before, so take advantage of it!

A night's searching is most rewarding when you intimately know the region of sky you're observing. Check orientations of bright stars and deep-sky objects and the visibility of each deep-sky object. Use the descriptions of deep-sky objects contained in magazines, catalogues, and atlases as rough guidelines only. Don't believe everything you read. Remain skeptical about which objects can and can't be seen with certain size telescopes until you check them out yourself. Observing involves the dynamic interaction of three key variables — observer, sky, and instrument (usually in that order of importance) — so every observer sees things differently. Finally, when you observe under premium sky conditions, push yourself to locate objects you might not expect to see. You may surprise yourself. There is nothing quite like the thrill of observing a deep-sky object you're not supposed to be able to see!

If you observe primarily from a light-polluted site, classifying objects into two categories — those which you have a reasonable shot at observing, and those you don't — is useful and expedient. This requires the good judgment you can only gain from observing experience. I find that if you save the most difficult objects for a very dark sky, you'll routinely have fun with the brighter objects and will be satisfied with making the most of the dark sky.

Another way to observe a sky region is to divide the objects by type. This method helps develop a discriminating eye for the distinguishing characteristics and minute subtleties of similar deep-sky objects.

The next step is actually observing at the eyepiece, which involves several considerations. The development of high-quality nebular filters is one of the most exciting changes in amateur astronomy in many years. For the first time amateurs with small scopes can easily see low surface brightness objects like the California Nebula. Accessories such as these can help amateurs see objects traditionally thought invisible.

The most important observational consideration is learning the "art of seeing" (see Jim Meketa's article earlier in this section). The key factor, the



"right stuff" for this critical element, is patience. To see what the sky has to offer requires the patience to see each object as an individual scene the universe is revealing to you. Patience distinguishes the quality of "seeing skills" between ordinary and advanced skilled observers. Seeing is a subtle art best learned by doing.

Some amateur astronomers feel that visual peeks at deep-sky objects are inferior to the photographs that appear in many books and journals. I assert that no set of photographs I have ever seen can compare with my observing experiences. For example, I have never seen a photograph of the Orion Nebula that compares with the view in my 10-inch reflector. There is a dynamic element to seeing "live" starlight that simply cannot be rendered in photographs. Photographs and eyesight are different ways of capturing a perception of reality at a static point in time. Each has its own advantages. Each has its own limitations.

Most observers are aware of the benefits of averted vision. The importance of learning and mastering this technique



is not to be underestimated. One variation of the technique I find extremely useful is gently sweeping the telescope back and forth over the region where an object is located while using averted vision. The motion seems to add apparent contrast between the object of interest and the background sky. This is particularly effective when you're locating extremely faint objects where there is no close guide star to hop from. I have observed many objects I would not have seen as easily without employing this technique.

The third main area to keep in mind is maintaining notes and records of your observations. In some ways this is the most important element because by recording observations, you'll build a "collection" of deep-sky objects and mark progress on your systematic search of the heavens. And by reflecting on your observations, you'll realize the significance of what you've seen.

Notes are short-term scrawlings made during an observing session, while records are more permanent explanations of what you see. There are several creative ways to keep track of your

observing experiences. There is no single "right" way, so I encourage everyone to develop a method that works best for him.

Taking notes during observing sessions, you will want to record several impressions or details for each object. Some of these include the object's brightness, size, distinguishing characteristics, orientation, and a drawing. There are two methods for recording these, including pencil and paper or a small tape recorder or dictaphone. The latter would be used primarily for convenience. If you wish to sketch an object, however, you must use pencil and paper. I encourage everyone to read the article on recording observing notes by Brian Skiff in *Deep Sky* #12, Fall 1985. This article is excellent and covers the subject in detail.

Permanent records of observations can be kept various ways. You should transcribe observing notes into more permanent records that can be efficiently managed and accessed. Here again there is room for creativity. Some may wish to keep permanent records in a notebook, while others may prefer to

store them in a computer database. Both methods require defining an organizational scheme. Use the method that works best for you.

Occasionally it may be useful to look at and think about the objects you have observed. A simple way to do this is to purchase a copy of Wil Tirion's *Sky Atlas 2000.0* desk edition (black stars on a white background) and use colored pencils to shade the objects you have observed. Select a color for each type of object (for example, star clusters could be yellow, nebulosities green, and galaxies red). In this fashion you will be keeping an ever growing mural of the sky as you have observed it.

The final part of the observing process is especially important. Observers need to *think* about their observations. The observing process should not end at the eyepiece or at the recording of an observation. Thinking about your observations will sharpen your skills and make you capable of taking on your own systematic survey of the sky.

3 Ridge Road
Route 2, Box 129 F
Buffalo, MN 55313

Texas Star Party Survives Freak Weather

by Dave Eicher

The normally dry, dusty basin surrounding the Prude Ranch in Fort Davis, Texas, was awash with rainwater and the sky variably cloudy throughout this year's Texas Star Party, held May 25-30. Two nights before the star party began, a tornado passed thirty miles northeast of the TSP site, leveling the small town of Saragosa, Texas. Traveling down to Fort Davis from the airport at Midland/Odessa, Bryan Shumaker and I drove through puddles of accumulated water on every low-elevation road we encountered. Several times we thought the little Mustang we had rented wasn't going to make it. At around 10 p.m. on Saturday, May 23, Bryan and I drove through what was left of Saragosa, spotting dozens of twisted trees and cars, flattened houses, and debris everywhere. When we finally pulled into Fort Davis, we breathed several sighs of relief.

Despite all this dramatic excitement, the Texas Star Party took place this year and was for the most part a success. Observers from all over the Southwest (and a few from more distant locations) brought telescopes of all kinds and looked forward to good weather. The good weather didn't come, but they got

a chance to observe several times during the week.

The telescopes varied from routine to unique. Frequent *Deep Sky* contributor Robert Reeves of San Antonio brought his enviable photographic rig that uses a welded steel cradle to hold an 8-inch Schmidt camera and a Celestron 8 guidescope on the same fork mount. Reeves uses freon gas fed into the camera's interior to keep humidity low. He also electrically heats the front ends of both instruments to prevent dewing.

Dewey Burkes of Houston brought a monstrous 16-inch telescope that looked like an anti-aircraft gun mounted on a trailer. The scope sits on an equatorial fork mount with a differential guiding system; its optics consist of a 16-inch f/4 full-thickness mirror and a rotating secondary that reflects starlight to one of two eyepieces for viewing comfort. The telescope can work as an f/16 Nasmyth-focus Cassegrain by deploying a plane mirror to divert starlight through the declination axis.

Veteran astrophotographer Jack Eastman of Sheridan, Colorado, brought an exquisite 6-inch f/15 Alvan Clark refractor. This telescope, still transported in its original wooden box, was

made in Cambridgeport, Massachusetts, by Alvan Clark & Sons in 1877. The instrument was used for many years at Center College in Kentucky before it was purchased by a telescope dealer. Jack acquired the telescope several years ago and has enjoyed showing people planets and deep-sky objects ever since.

Deep Sky contributing editor David Higgins and friends Philip Scott and John Elrod brought a mammoth 24-inch f/4 reflector, the largest telescope at this year's TSP. The telescope was built by Joe Pearson and John Dutton of Oklahoma City and provided magnificent views of many dozens of deep-sky objects during clear moments throughout the week.

But much more happened at the TSP than telescope showing. Several nights presented attendees with partially clear skies or periods of horizon-to-horizon clarity. When these moments came, observers were quick to seize them. The usual method was starting with Omega Centauri, moving to NGC 5128, and then foregoing the bright stuff and looking for challenging objects that made the most of the Texas sky. A group from Houston and one from Oklahoma City



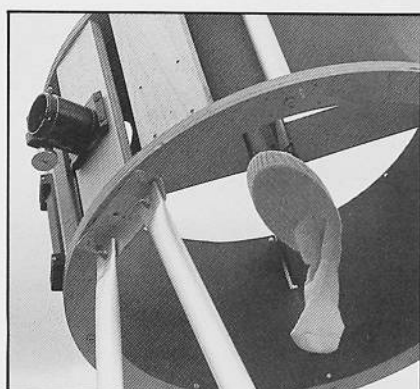
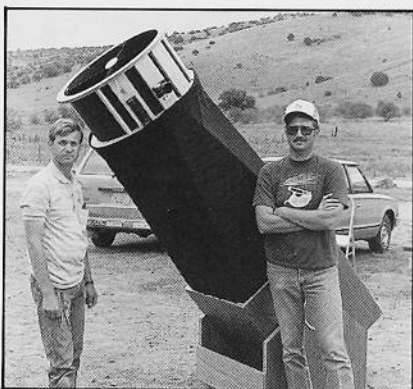
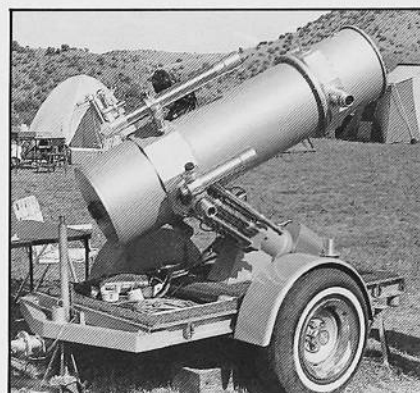
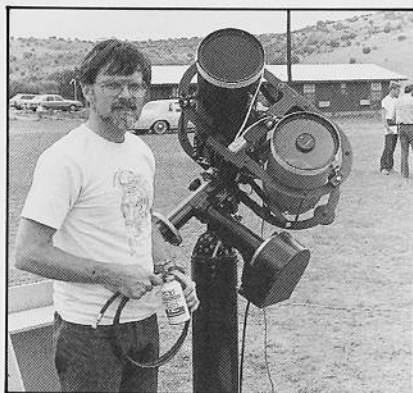
Below, clockwise from upper left: Robert Reeves with his tandem Schmidt camera and Schmidt-Cassegrain guidescope mount; Dewey Burkes' magnificent 16-inch combination Cassegrain/Nasmyth focus telescope on a massive trailer; close-up of the unconventional secondary cover used by DSM contributing editor David Higgins; the complete Higgins telescope, a 24-inch f/4 reflector co-owned by Philip Scott and John Elrod and built by Joe Pearson and John Dutton. Photos by Dave Eicher and Brian Skiff.

Bottom: This three-piece mosaic photo of the Prude Ranch and surrounding Lympia Creek Canyon was made during this year's TSP by Arizona amateur Chris Schur.

searched for faint Abell galaxy clusters. Several observers were hunting for quasars. A group led by David Levy found Comet Halley, a mere spot of light in a field of several galaxies. A large group near the 24-inch scope found Pluto, and among the observers of Pluto and Comet Halley was Clyde Tombaugh, Pluto's discoverer.

Although some observing happened, this year's TSP was generally cloudy. Several evenings were spent sitting outside, waiting for the sky to clear. But the TSP isn't *all* astronomy: I also rode horseback, explored old Fort Davis, and sampled the dangerously authentic Mexican cuisine in town. This year's TSP was especially memorable for me, because I was given the Lone Stargazer Award for contributing to astronomy and am flattered to join the ranks of past winners Walter Haas, David Levy, Brian Skiff, Clyde Tombaugh, and John Waggoner.

I want to thank TSP organizers Mike Dennis, David Higgins, John Elrod, Joe Pearson, Larry Beatty, Clive Cadle, and the rest of the Oklahoma group for ensuring that, despite tornadoes and frequently cloudy skies, all who attended this year's TSP had a grand time.



STELLAFANE 1987

by Mike Witkoski



Along with *Deep Sky* editors Glenn Chaple, Phil Harrington, and Richard Berry, I was among the attendees at the fifty-second Stellafane convention in Springfield, Vermont, on July 24-25. Russell W. Porter, one of the founders of this premier amateur telescope making event, would have been proud of the two thousand or so enthusiasts who braved the oppressive heat and humidity (the only relief would have been rain showers, which didn't come anyway, despite constant threats.) Homemade telescopes up to 30 inches abounded, all at least in part stemming from Porter's inspiration. Although Porter has been dead for nearly forty years, his insights into telescope making, which varied from building backyard instruments with discarded materials to extensive design consultation for the 200-inch Palomar giant, influence us still.

This year marked a transition in Stellafane history, the last time the extensive lower parking area and campground were available. For several years Stellafane's future was seriously threatened by the impending loss of the use of this land, but fortunately late in 1986 the Springfield Telescope Makers acquired thirty-three acres about a quarter mile from the main clubhouse. The legendary gatherings will now continue.

In his annual Shadowgram talk Walter Scott Houston stated that Stellafane is still the "model" event of its kind and that "Riversiders and Texas Star Partiers commonly ask how Stellafaners do things." Springfield, Vermont, a little niche of northern New England that is the birthplace of amateur tele-

scope making, has hosted conventions since 1926, while Riverside and the Texas Star Party started in 1966 and 1982, respectively.

This year's highlight was Saturday's keynote address by John Dobson of the San Francisco Sidewalk Astronomers, the well-known designer of the large reflecting telescopes that bear his name. The laid-back talk entertained, although it carried a strong message to open up the skies to the masses who may otherwise never have the opportunity to observe. Dobson has traveled extensively, particularly to our national parks, with his large-aperture instruments, giving countless thousands of people their first look through a telescope. He implored the audience to do the same — we have the knowledge; therefore, we should share it. He emphasizes that his mission has not been to revolutionize telescope making as an end but only as a means to show the heavens to as many people as possible.

I had the opportunity to chat with and photograph Dobson. He posed with Gary Walker of Massachusetts, who built a 14.5-inch equatorial Dobsonian with a split-ring mount, a design patented by Porter in 1918 and used for his elegant garden telescopes in the 1920s. Foam core board covered with formica makes Gary's telescope very light. It is not only aesthetically pleasing but large and practical. Fittingly, it won two ribbons.

George Briggs of Princeton, New Jersey, shared a prize with Gary for his binocular telescope consisting of two independent f/3.6 Comet Catchers. Two

25-power Erfle eyepieces yield a 65° apparent field and a 2.6° field of view. When observing through George's instrument, one's back is toward the sky. Several other binocular telescopes were in the competition this year. Coincidentally, Phil Harrington gave a tent talk on observing with binoculars. His main theme was that this often overlooked instrument can open new vistas to observers.

Glenn Chaple and I spent a lot of time together over the weekend. We first met here in 1980, following a talk he gave on double star observing. Looking back on my eight consecutive Stellafanes, I've seen tremendous strides in telescope making, from large Dobsonians to binocular scopes to homemade refractors to computer-controlled drives. Similarly, commercial telescopes have expanded and improved, partly because of healthy competition.

As a result, observing the sky has changed. Dim galaxies, subtle nebulae both bright and dark, and close binary stars that would have been out of the question for amateurs a few years ago are now part of regular observing programs.

While eyepieces and filters have advanced commercially, homemade telescopes have become more compact and portable. Change is constant, and let us hope it continues for the better. Next year's Stellafane will be different from others, because of the change in setting, but with continued strong support and close camaraderie, it can only move forward. I'll be looking forward to seeing as many of you there as possible.



Clockwise from left: Dean of the deep-sky observers, Scotty Houston chats with an amateur and shows off his Supernova 1987A T-shirt. Glenn Chaple and son David are happy to be on Breezy Hill. Porter's Turret Telescope, built in 1930, still provides stunning views to Stellafaners. Sky & Telescope columnist John Bortle attends his twenty-fourth Stellafane. George Briggs shows his highly praised binocular telescope. Featured speaker John Dobson and Gary Walker smile for the camera. Photos by Mike Witkoski.

Small Scope Showcase

Autumn Clusters and Nebulae

by David H. Levy

When is a cluster not a cluster? When you can't resolve it into stars and you think it is a nebula. For centuries astronomers used the word "nebula" (Latin for cloud) as a catch-all term to describe almost anything nonstellar in either appearance or concept.

When Halley, Messier, the Herschels, and the Earl of Rosse began discovering deep-sky objects by the hundreds, they described these objects according to their appearances and emphasized whether these objects could be resolved into stars. Those that could were clusters; anything that remained stubbornly unresolved was called a nebula.

The habit persisted well into this century. Even after the vast differences between local (true) nebulae made of gas and dust on the one hand and distant galaxies on the other were clear to every astronomer, Edwin Hubble still led a large group of astronomers that insisted on calling everything a nebula. In his phraseology, M31, prominently visible in this season's sky, was called an "extragalactic nebula."

The confusion this has caused for beginners is immense. You might think that with everything in the sky being either a star or a cloud, things would be simple. But there's just no comparing a cloud of gas and dust 25 light-years wide and 1,600 light-years away with a swarm of stars, dust, and gas clouds 80,000 light-years wide and millions of light-years away. The physical realities differ so vastly that to knowingly call them both nebulae borders on fraud. Therefore the Harvard astronomer Harlow Shapley (who disliked Hubble anyway) always referred to the "extragalactic nebulae" as *galaxies* and his terminology prevails today.

Let's begin this autumn with a galaxy. It is an old friend, **M31** (NGC 224) in Andromeda. M31 is not, as some textbooks claim, the galaxy closest to ours. (That distinction goes to the Large Magellanic Cloud, seen best from the Southern Hemisphere.) It is, however, the nearest spiral galaxy.

Through binoculars and under a dark sky I have seen M31 stretch over several degrees of sky. Through a small telescope its spiral nature becomes evident and through my 16-inch scope I can see huge lanes of interstellar matter

and even a few bright (real!) nebulae of ionized hydrogen gas, known as HII regions.

Some Real Nebulae . . .

M45, the Pleiades. About 410 light-years away, M45 is one of the most prominent open clusters in the sky. To see the nebulosity that surrounds some of the Pleiades stars, use either giant binoculars or a low power, wide field telescope on a moonless night. Nebulosity is particularly evident around the stars Merope (NGC 1435) and Maia.



M1 (NGC 1952), the Crab Nebula. One of the youngest nebulae, the Crab is the sky's most obvious representative of something old — the explosion of a supernova. The Crab supernova was first seen on July 4, 1054, and is one of the oldest recorded galactic supernovae. It was visible for months without a telescope. We are fortunate with the Crab because not all supernova remnants are so bright. The youth of the expanding cloud explains the Crab's easy visibility. In a small telescope with moderate magnification you can see that its misty outline is irregular, but the tendrils of outrushing gas that earned it its nickname can be seen only in large telescopes.

NGC 1931. This small nebula in Auriga is illuminated both by emission and reflection of starlight from an open cluster also called NGC 1931. Although photographs show the nebula as amorphous and filamentary, visually it appears like an irregular patch of nebulosity whose light is almost overwhelmed by the cluster. In a constellation monopolized by the huge open clusters M36, M37, and M38, this

little object is usually ignored. It shouldn't be.

. . . And a Few Globulars

Although summer is the best time to look at the rich supply of globular clusters inhabiting the region around the center of our Galaxy, autumn offers some nice clusters too.

M71 (NGC 6838). One of the strangest globulars in the sky, M71 confused astronomers until several decades ago. Many of them thought that instead of an unusually loose globular, it maybe a very rich open cluster. Maraldi came across this cluster while looking for Comet de Cheseaux of 1746. It is 13,000 light-years distant and shines at magnitude 8.3. The large number of red giants found in the cluster indicates it is indeed a globular. Its shape also is curious: though it looks like a globular, it has a large streamer of stars that is definitely atypical of globulars. M71 is the highlight of Sagitta, easy to find and interesting to study.

M75 (NGC 6864). This is the most concentrated of all Messier's globulars and the only one with a Shapley-Sawyer class of I (the most concentrated). It occupies 6' of sky and shines with a visual magnitude of 8.6. One of the most distant of the Sagittarius clusters — and of all the Messier globulars — it is roughly 60,000 light-years away.

M15 (NGC 7078). This is the cluster of choice for the Northern Hemisphere autumn sky. Just 4° west and a little north of Epsilon (ε) Pegasi, M15 is easy to find. Even though it is a fairly concentrated class IV cluster, it is resolvable even with a 6-inch telescope. Its visual magnitude is 6.4 and it is 31,000 light-years distant. This moderately concentrated cluster has some apparent streamers or lanes of stars visible on its outskirts, a feature that occurs occasionally in bright globulars.

M2 (NGC 7089). One of the finest clusters in the northern sky, M2 is easily visible in binoculars where it looks like an out-of-focus star. A practiced observer can begin to resolve this cluster with a 6-inch telescope, although with larger instruments the cluster resolves more readily into thousands of stars. It is a highly concentrated type II cluster, with a V magnitude of 6.5, and we see it from the great distance of 37,000 light-years.

You can find M2 by moving west of Alpha (α) Aquarii until you reach a position just north of Beta (β) Aquarii. M2 forms a triangle with those two stars. When you see it, you will get a thrill that discoverers Maraldi and Messier

could hardly have had with their much smaller telescopes.

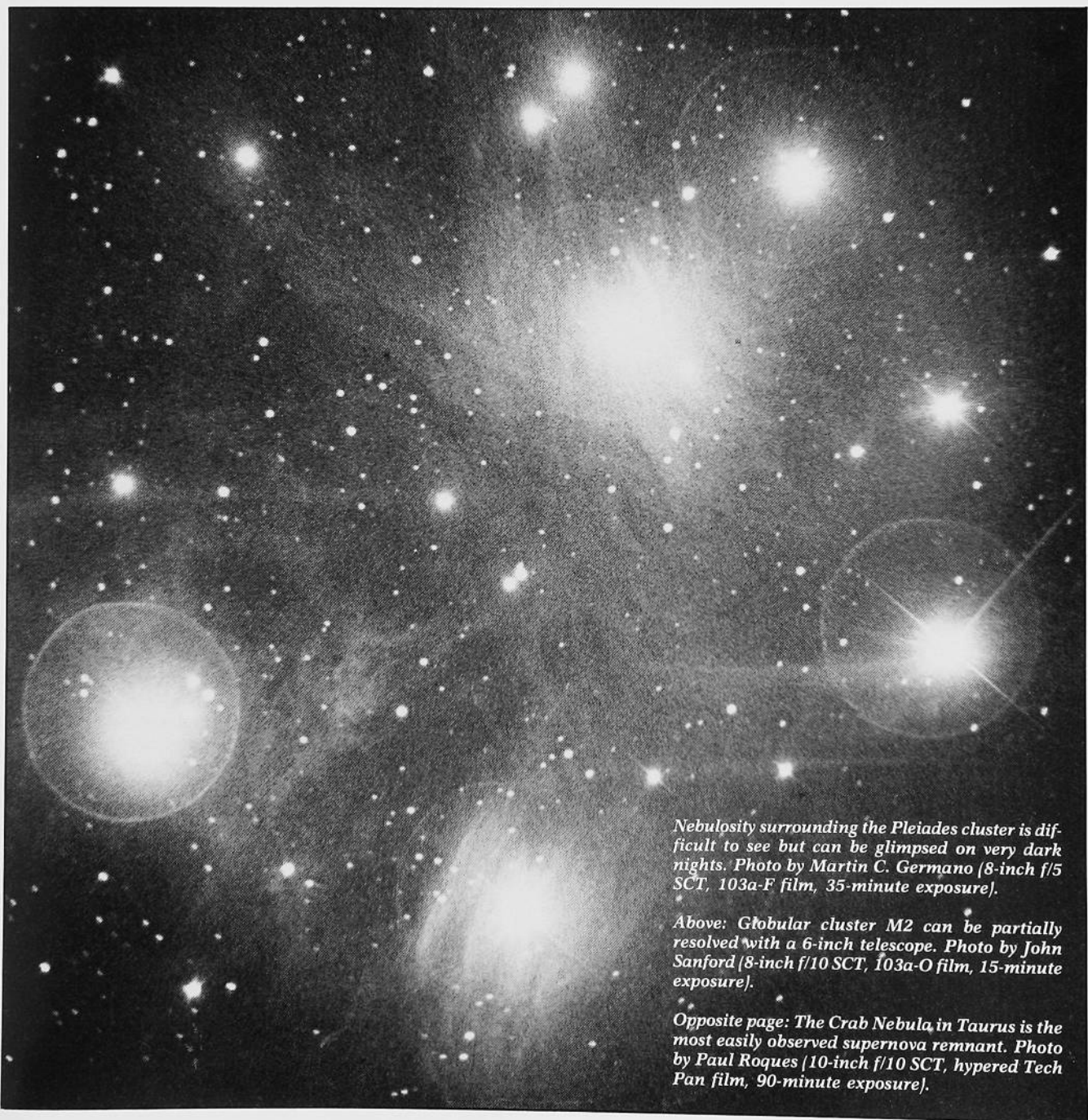
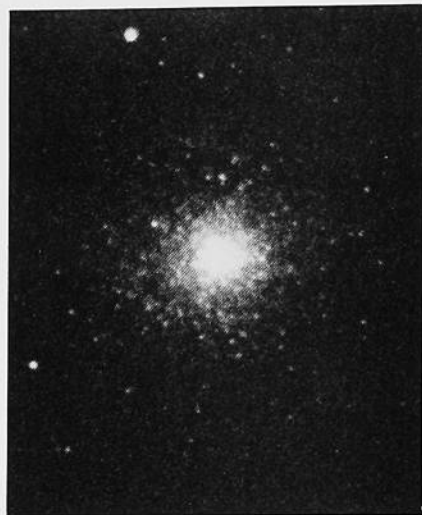
Messier found M2 as he was searching for comets. In 1975 two observers found a comet while searching for M2! Doug Berger came across a fuzzy object that was not resolvable and a few days later Dennis Milon also found a fuzzy patch in the region of M2. They shared in the discovery of comet Kobayashi-Berger-Milon, one of the year's brightest comets.

M30 (NGC 7099). "Seen with difficulty in an ordinary telescope of 3-1/2 foot [focal length]." This is part of Charles Messier's description of this cluster, written in 1764. You can find M30 easily just west of 41 Capricorni, usually in the same low power field. Its

magnitude is 7.5 and it is 27,000 light-years distant. Its classification of V indicates that it is about average in concentration, although some photographs indicate that it has a tighter concentration than that.

If you've ever tried to see all the Messier objects in a single night — an undertaking usually done on a spring night and called "a Messier Marathon" — M30 will be one of the hardest to find. In spring it rises just after dawn, making observation almost impossible. But observing this fine globular under such poor conditions does not do it justice. To observe M30 in all its glory, early fall is the best time.

Route 7, Box 414
Tucson, AZ 85747



Nebulosity surrounding the Pleiades cluster is difficult to see but can be glimpsed on very dark nights. Photo by Martin C. Germano (8-inch f/5 SCT, 103a-F film, 35-minute exposure).

Above: Globular cluster M2 can be partially resolved with a 6-inch telescope. Photo by John Sanford (8-inch f/10 SCT, 103a-O film, 15-minute exposure).

Opposite page: The Crab Nebula in Taurus is the most easily observed supernova remnant. Photo by Paul Roques (10-inch f/10 SCT, hypered Tech Pan film, 90-minute exposure).

Double Stars

A New Direction

by Brian Skiff

Having looked at most of the galaxies, clusters, and nebulae plotted on the *Tirion* atlas, I have now turned my attention to double stars. Glenn Chaple has been kind enough to let me ramble on in this column while he concentrates on spotting outbursts of exotic variable stars and appearing on every tenth IAU circular.

The principal instrument I've been using for double star observing is the Lowell 24-inch f/16 refractor. This may seem unfair compared to the 3-inch reflector Glenn Chaple frequently used. However, the Clark is fitted with a large iris diaphragm that allows the aperture to be reduced to as small as 6 inches. At this relatively tiny opening (f/64!) the telescope gives textbook diffraction images, the 0.85 arcsecond Airy disk

clearly discernible at moderate powers. Various eyepieces give a convenient range of useful magnifications up to about 600x. Because of the vagaries of atmospheric seeing (Flagstaff's fine seeing is a myth, by the way), I usually observe with the telescope stopped to less than 12 inches in aperture, well within the range of instruments owned by *Deep Sky* readers.

Because the Clark's focal length is nearly 32 feet, double star photography is a piece of cake. As an example of what can be done without effort, here is a shot of 70 Ophiuchi, currently closing at a separation of about 1.8 arcseconds. This is a 2-second exposure on Kodachrome 64 with the telescope stopped to 10 inches.

The fine filar micrometer made by the Clarks for the telescope has been resurrected for double star measurements. My experience with this instrument so far is limited. Nevertheless, the repeat-

ability of my measurements on pairs in the 1 to 10 arcsecond range shows errors of about 0.1 arcseconds in separation and 0.5 degrees in position angle. I can also say that this filar micrometry is the most difficult sort of visual observation I have ever attempted; my respect for the masters of this art grows with each setting on a close pair.

Glenn has insisted that I not forget the small telescope crowd. To that end I will use my 6-inch f/8 apochromatic refractor together with simple cardboard stops for smaller apertures.

Two other Lowell telescopes may on occasion come in handy for our purposes. A 17.7-inch f/8 astrograph will prove useful for determining relative and absolute positions of fainter pairs wider than about 10 arcseconds, which have often been neglected for several decades and are in need of measurement. To determine magnitudes of unstudied pairs, there is a 21-inch photometric telescope I use literally every clear night for my regular work. These photoelectric measurements will be quick and dirty compared to what one might publish in a professional journal, but they will be entirely satisfactory for our visual purposes.

Besides an array of telescopes, an observatory provides another indispensable resource: a library. I plan to publish lots of data from the journals as they appear, specifically photometry, spectral types, and new orbits and ephemerides. Newly discovered doubles announced on the IAU Double Star Commission's *Circulaires d'Information* will also be featured. One fundamental data source will be the USNO *Washington Index of Double Stars (WDS)*, which summarizes micrometric measures for 75,000 multiple systems known up to 1984. For history buffs the Lowell library even includes an original edition of Struve's *Mensurae Micrometricae*, published 150 years ago.

Among the systematic observations I am pursuing, the most fun is a survey of about five hundred "visually interesting" double stars contained in the *Yale Bright Star Catalogue (YBS)*. The YBS contains about nine thousand stars and is essentially complete to magnitude 6.5 or so. I have defined "interesting" pairs to mean those between 0.5 and 10 arcseconds (with a few notable wider exceptions) and with a magnitude difference less than 3.0 (likewise with a few exceptions). Because they are among the brightest pairs, these are the best studied: a large proportion have

ADS	Other Name	R.A. (2000)	Dec.	V	Sep.	P.A.	Year	MK (Spectral Type)
14592	12 Aqr	21h04.1m	-5°49'	5.9, 7.3	2.5	194	1973	G4III & A3V
A pair with contrasting colors that Hartung found easy in 7.5cm; Webb saw the colors as yellow and blue. The primary was resolved via speckle interferometry into a pair only 0.06" apart (in 1983).								
15578	Cyg	22h02.9m	+44°39'	5.6, 8.1	0.94	3	1986	A0IV
A mag 10.5 companion at 67"; p.a. 309°.								
16979	107 Aqr	23h46.0m	-18°41'	5.7, 6.7	6.6	136	1975	F2III & F2V
Hartung found this pair to be easy in 7.5cm. Webb reports a variety colors by various observers, but Rakos <i>et al.</i> measure $\Delta B - V = 0.10$, suggesting only a subtle color difference. Abt determines the spectral types to be A9IV & F2V.								
111	κ^1 Scl	0h09.3m	-27°59'	6.1, 6.2	1.6	260	1982	F4III & F3III
Hartung: cleanly resolved in 10.5cm.								
683	65 Psc	0h49.9m	+27°43'	6.3, 6.3	4.6	296	1970	F4III & F5III
Hartung: excellent for small apertures.								
1697	6 = TZ Tri	2h12.4m	+30°18'	5.3, 6.9	4.01	70	1985	G5III & F5V
Another contrasting pair, but the color difference is smaller than in 12 Aquarii; Webb calls them yellow and blue. Both components are spectroscopic binaries. The system is variable by 0.08 magnitudes, but the type of variability is uncertain. The YBS says this <i>not</i> iota Trianguli, as it is labeled on the Trion atlas.								



The Lowell Observatory 24-inch f/16 Alvan Clark refractor.

Left: The 1.8'' binary 70 Ophiuchi photographed with the 24-inch Clark stopped-down to 10 inches aperture, Kodachrome 64 film, and a 2-second exposure.

Below: The front end of the 24-inch showing the diaphragm stopped-down to an aperture of 6 inches. All photos by Brian Skiff.

good magnitudes, spectral types, orbits, and so on. A representative sample of six doubles from the YBS list suitable for observation in the fall are listed in the table. I will be pleased to collect observations of these stars to produce a summary for publication in a later issue. (I haven't looked at them yet myself, so I'll be covering new territory at this end too.)

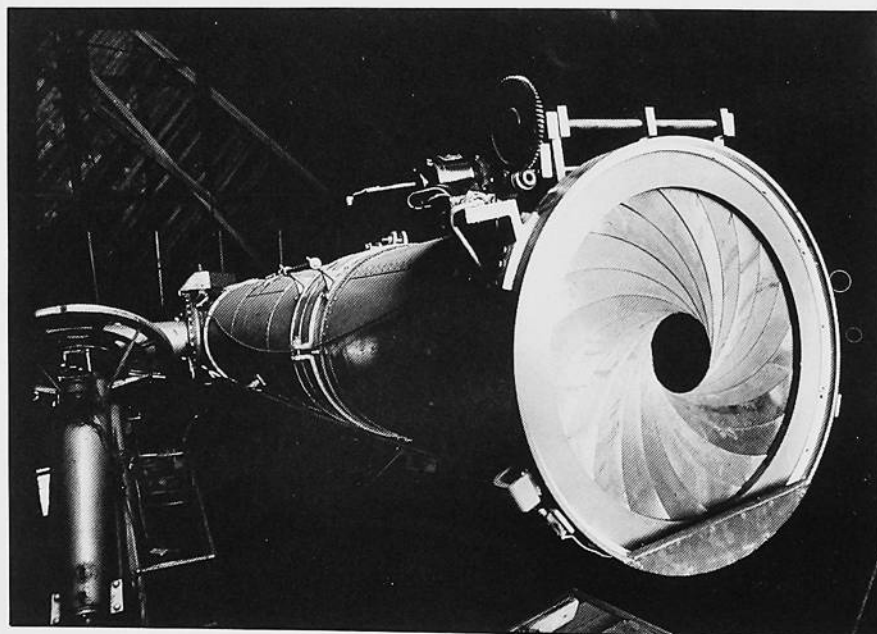
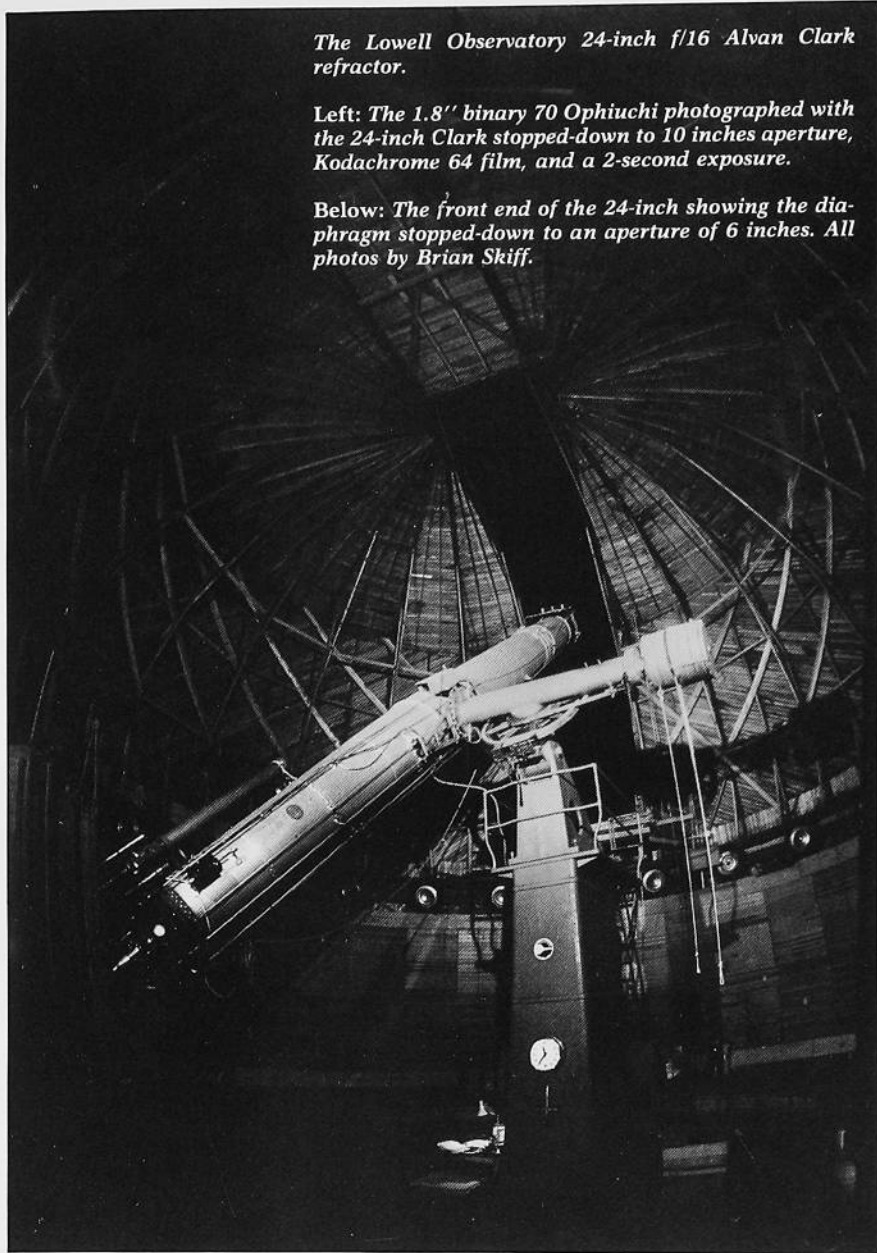
If we go a couple of magnitudes fainter and expand the observing list to include the sample collected in the *Sky Catalogue 2000.0, Volume 2*, I estimate there are about 2,500 "interesting" pairs by the criteria mentioned above. Obviously there's no shortage of stuff to look at even with a 6-inch or 8-inch telescope.

I am still in the learning stages of this type of observing, so old topics covered during the Chaple era will inevitably reappear. I have made a list of the stars Glenn mentioned, and echoes will be heard as appropriate. Discussions of the geometry of the diffraction image, resolution limits, colors of double stars, orbital motion, and others are likely to crop up. Please remember that my responses from you will strongly influence the direction the column takes. Let's hear from ya!

Bearing this in mind, the selection of double stars will emphasize relatively bright, close pairs. My work thus far indicates that these pairs are at least as interesting as the brightest deep-sky objects; the best of them are fascinating. As an observational approach I would like to balance the aesthetics of visual observation with the strong tie to more quantitative measurements like magnitudes and orbit ephemerides. For me purely visual observation exists in a void where it is not grounded on measurements. The solar astronomer Marcel Minnaert put it better:

It is indeed wrong to think that the poetry of Nature's moods in all their infinite variety is lost on one who observes them scientifically. The habit of observation refines our sense of beauty and adds a brighter hue to the richly colored background against which each separate fact is outlined.

421 West Aspen
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Variable Stars

A Variable Night in Autumn

by David H. Levy

I suffer from observer's itch — that dire, incurable complaint known to all who own telescopes.

All day long the passing cumulus clouds played games with us. Did the clouds announce the end of the storm, or could we expect more clouds that night? With cooling temperatures and a setting Sun, the clouds finally move out and it looks as if a "variable night" is about to begin.

As the sky darkens I look to see if any novae have appeared since my last check. Nothing is obvious, at least down

to 3rd magnitude. How do I know? Well, it's not an exact search, but I can spot an interloper that appears out of place. It's not as hard as it sounds. When you get familiar with the stars, you see changes. A good test is when a passing bright satellite — as yet unnoticed — gives you the impression that "something's wrong" in the sky.

At least down to 3rd magnitude, however, the sky looks unchanged — so from newcomers I next move to old friends. A quick look at SS Cygni to see what it might be doing. Tonight it's shining at magnitude 8.9, so it definitely is in an outburst. But going up or down? Three nights ago it was quiet at 12.1, and because its outbursts usually last several days, my guess is that it has almost reached the height of a brand new maximum. Tomorrow I will call

the AAVSO with that report.

Observers work furiously on those rare nights when the stars are bright and the sky is dark. That's when a special feeling of activity takes over. When we are working this well, stars appear like old friends through our telescopes, and when the night is over, we close up feeling satisfied.

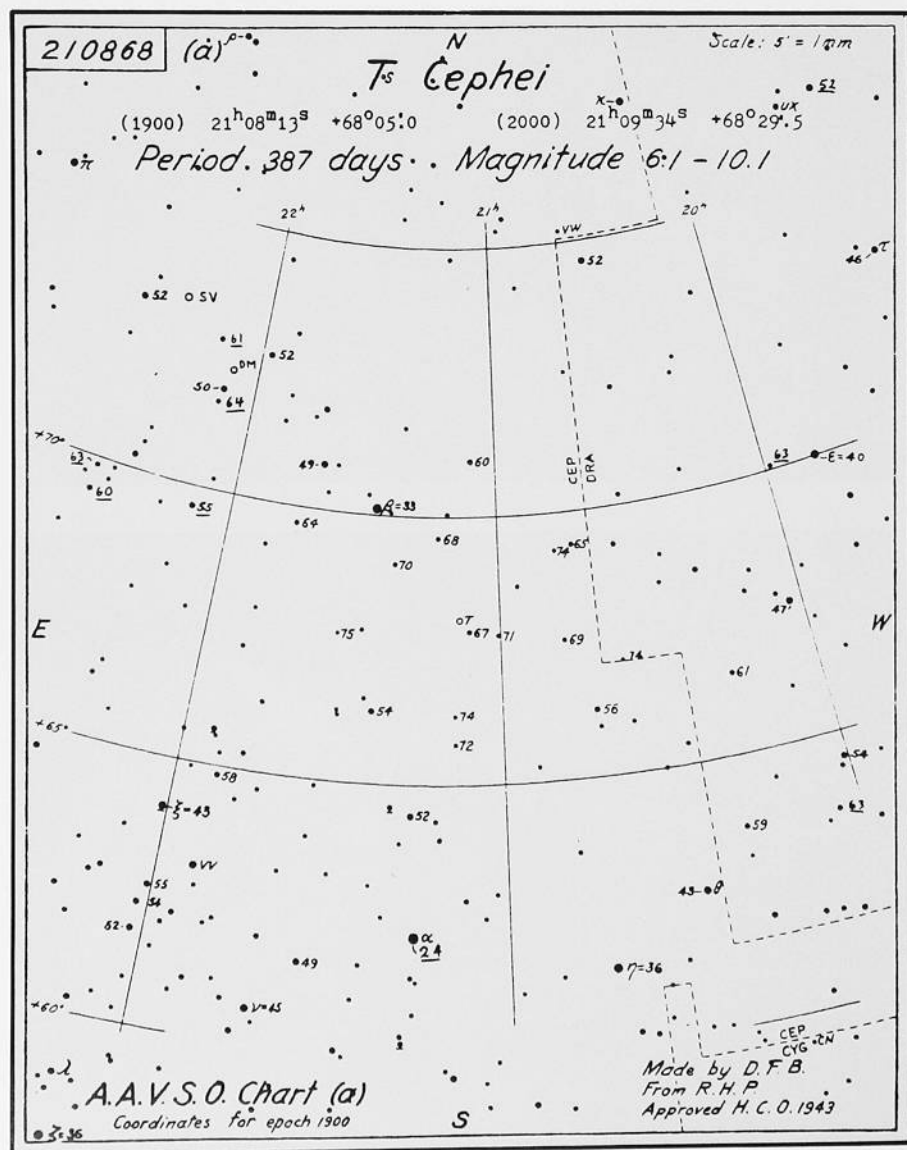
223201 CY Aquarii. Range 10.5 to 11.3; period 0.06 days. This RR Lyrae variable (also known as a "cluster variable") rises from its minimum of 11.3 to a maximum of 10.5 in slightly less than ten minutes! Although its fade is much slower, CY Aquarii is still one of the fastest RR Lyrae stars that most Northern Hemisphere observers can watch. It has a period of about 88 minutes. Estimate it every five minutes during falls, every one or two minutes during rises. Imagine the surprise of Alfred Jensch of Sonneberg Observatory when he was asked to check a suspected variable in Aquarius back in 1934 and found this star!

224049 RV Lacertae. Semiregular variable, range 9.5 to 11.4; uncertain period, officially listed as 67 days. However, the *General Catalogue of Variable Stars (GCVS)* reports a variation in the mean magnitude over roughly two years and the variation can apparently stop altogether for up to a year.

225248 EW Lacertae. Tiny irregular variations of a third of a magnitude characterize this special star. In some ways it resembles an RR Lyrae star with shallow variations over 0.7 days, but the GCVS reports that not all the minima actually took place! At least this was the story for one year (1951), but the following year the "period" did not follow this pattern at all. EW Lacertae is surrounded by a shell of material and it may also have a large and variable star-spot causing the strange cycles of variation. In any case I include this star for interest's sake — not for actual observation, because the amplitude is too shallow for accurate visual observations.

213678 S Cephei. A north circumpolar star that is observable year round from most Northern Hemisphere sites. This fortunate position enables you to watch this star complete cycle after cycle without any breaks. It varies by six magnitudes (from 8.1 to 13.2 and back) in a period of 485 days. Enjoy a look at this red Mira star once every two or three weeks.

210868 T Cephei. A bright Mira star 2° south and less than 2° west of Beta (β) Cephei. It is not close to a bright star, so you may have to work a little to find



it. Its magnitude 6.0 maximum makes it one of the brightest Miras in the sky, and even at minimum it is still at magnitude 10.3, which allows you to follow it easily in a 6-inch telescope.

005381 U Cephei. An eclipsing binary star with a difference: U Cep is undergoing a change of period, possibly because it is exchanging gas from one star to the other. Discovered by V. K. Ceraski of Moscow in 1880, this star drops more than two full magnitudes — from 6.7 to 9 — in slightly less than 2.5 days. The period is changing but in two different ways. It is increasing gradually by a very slight amount but — rarely — it can change more suddenly.

234102 TX Piscium. A bright, irregular variable with a one-magnitude variation between approximately magnitudes 6 and 7. Easily found in the semicircle of 4th-magnitude stars south of the square of Pegasus. Estimate once a month.

020448 RV Andromedae. Semiregular variable; 9.0 to 11.5, 172-day period. The lack of bright or well-known stars nearby make this star a bit difficult to find.

005840 RX Andromedae. Z Camelopardalis star, range 10.3 to 13.6. Look about $1/3^\circ$ east and slightly south of 6th-magnitude 39 Andromedae. Period approximately 14 days when star is not sitting at a standstill somewhere between maximum and minimum doing nothing at all.

005060 Gamma (γ) Cassiopeiae. In the center of the "W" of Cassiopeia is Gamma, nominally the third brightest star in the Queen. This star is an irregular variable that can undergo remarkable changes over uncertain periods of time.

Although Gamma Cassiopeiae usually shines at magnitude 3.0, it began to brighten slowly in 1937 until it reached almost magnitude 1.5. Records of that remarkable event show that the star brightens over weeks, instead of quickly like a nova. Moreover, the brightening (about 1.5 magnitudes) is not unusual, but when it happens to a 3rd-magnitude star that object can become one of the brightest stars in the entire sky.

Stars like this are losing mass slowly, so the material forms either a shell that covers the star or a disk. It may be changes in the thickness of the shell that result in the brightness changes. In 1965 Gamma Cassiopeiae again showed signs of brightening and observers watched carefully for a repeat performance.

During the observing season of 1966 I noticed some small fluctuations of a quarter magnitude over a period of weeks, but never anything more. The rise of Gamma Cassiopeiae is so slow that it could sneak up on you without you being aware of any change! In fact, the appearance of the entire constella-

tion offers a test of your visual perception. You are familiar with how the "W" is supposed to look and a casual glance after dinner will probably show Cassiopeia exactly as you remember it. (Small changes are absorbed by your mind and ignored, so the resulting picture is precisely what you expect.)

Now look at the constellation more closely. Is what you see really there, or has Gamma shown a subtle change in brightness? Training in such perceptive skill is part of what variable star observ-

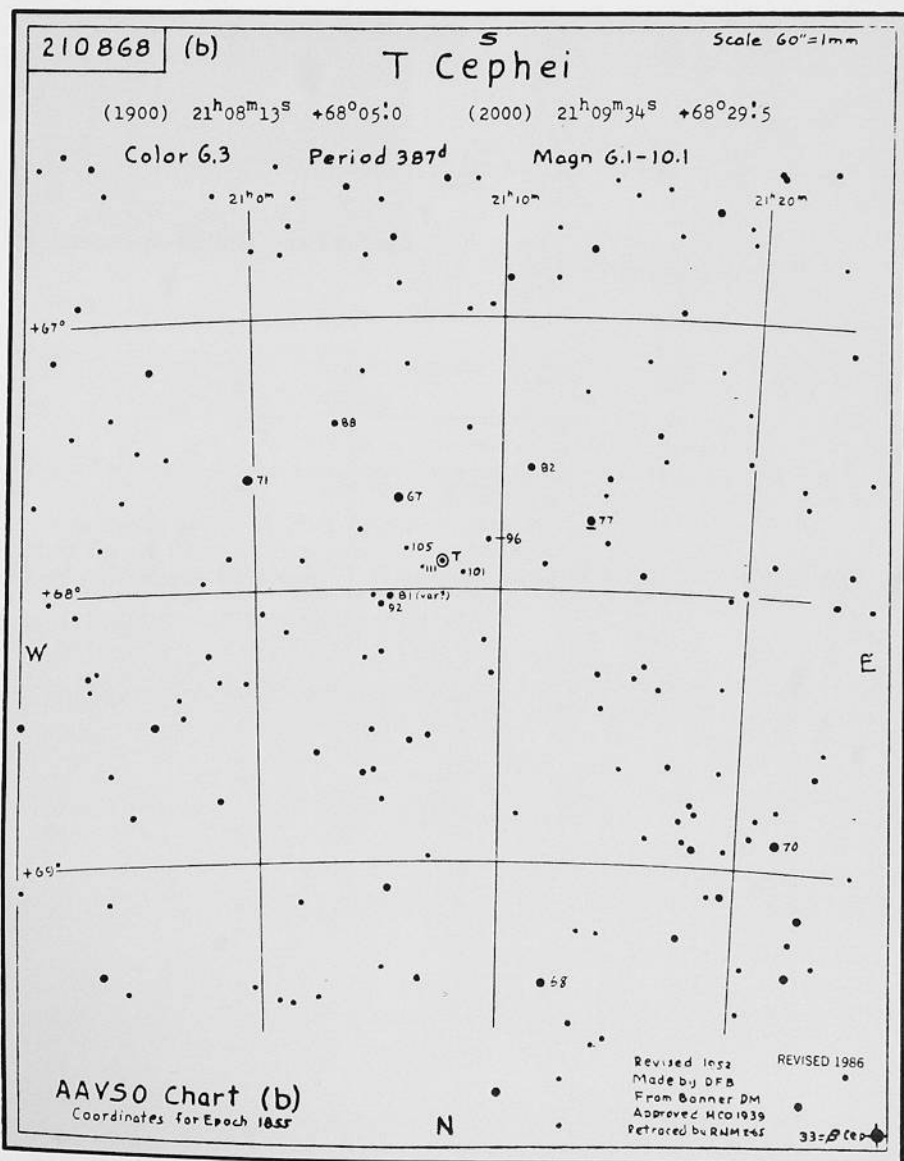
ing is about. This star and other unusual ones help us think about what we see and help us to see more effectively.

024217 T Arietis. This semiregular variable star (range 8.3 to 10.9) varies over a leisurely period of 323 days. You can get to it quickly by finding 5th-magnitude Pi (π) Arietis and then moving a scant $1/4^\circ$ west and a touch north. Don't estimate it too often, however — one look a month suffices.

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The bright Mira-type variable star T Cephei is easy to find. Not only does it lie 2° west of the bright star Beta (β) Cephei, but the variable is located only 1° northeast of reflection nebula NGC 7023. Lick Observatory photo.



Scanning the Literature

May-August 1987

by Brian Skiff

How much astronomical research can you do with a C-90? Lots, it turns out, when you mate the tiny telescope with a state-of-the-art CCD camera. Just such a combination was used by Stephen Kent to map the outer regions of large nearby galaxies difficult to measure by conventional aperture photometry ("Surface Photometry of Six Local Group Galaxies," *Astronomical Journal* [A] 94:306, August 1987).

To get full coverage of these galaxies, Kent used instruments ranging from a single 72-inch mirror of the MMT down to an enlarging lens of just 4 inches focal length. The large telescopes were used on the inner regions, while smaller optics gave wide fields of view for the outer regions.

One result of compiling the images was integrated magnitudes for the five brighter galaxies of the Andromeda group. Kent's new values are listed below along with those from the RC2 for comparison.

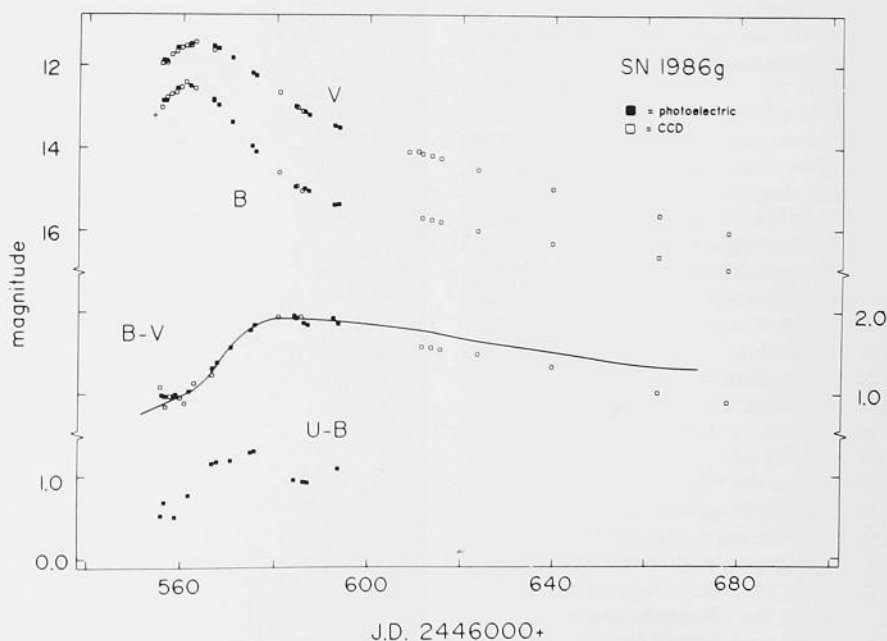
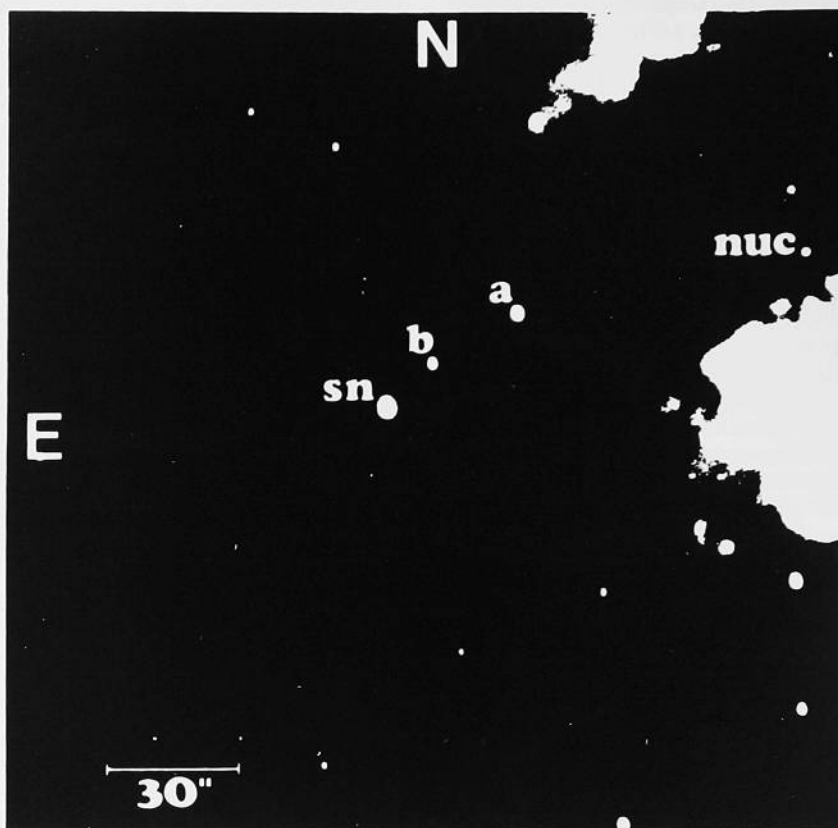
	V_T	
	Kent	RC2
M31	3.28	3.45
M32	8.06	8.21
N205	8.06	8.01
N185	9.13	9.17

A thorough structural analysis of the Virgo Cluster has been made by Bruno Binggeli, Gustav Tammann, and Allan Sandage ("Studies of the Virgo Cluster VI. Morphological and Kinematical Structure of the Virgo Cluster," *AJ* 94:251, August 1987). This work is based on a large catalogue of data and other results published in prior papers of this series — several of which have been cited in this column.

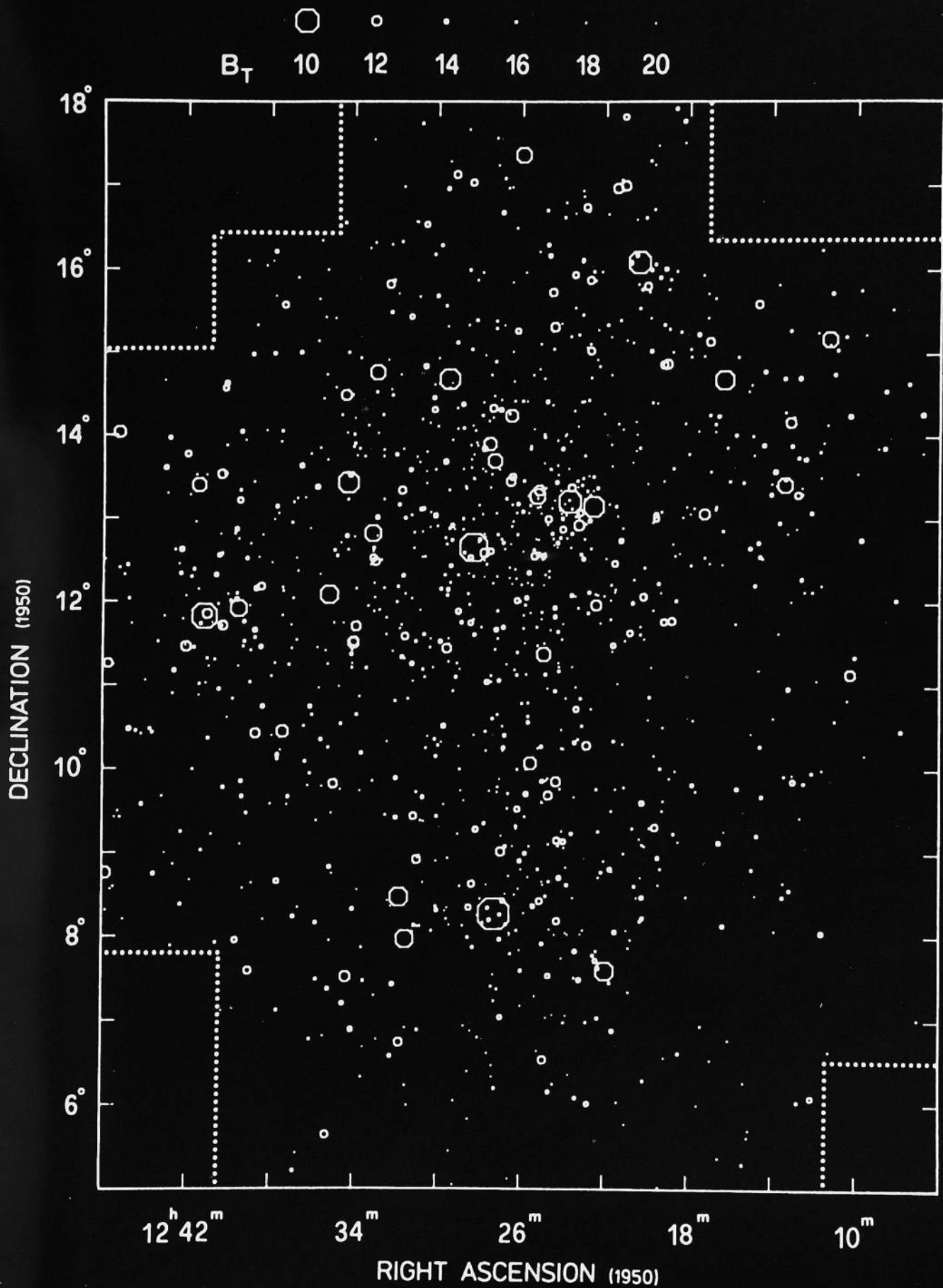
Among many interesting and controversial conclusions drawn:

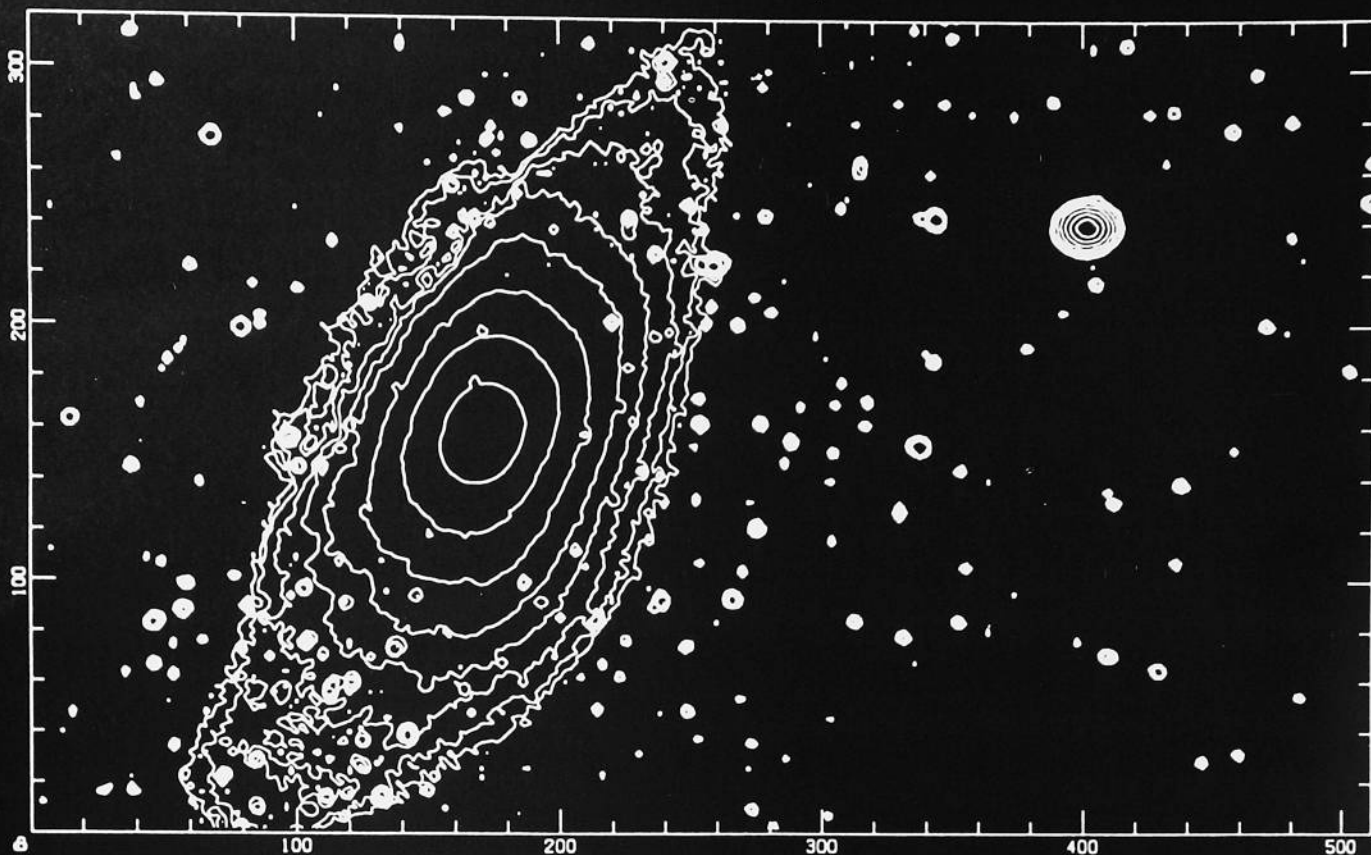
The Virgo Cluster shows a pronounced double structure. The two previously known concentrations around M87 on the north side and M49 on the south are clearly defined here. The M87 cloud consists mostly of elliptical and lenticular "early-type" galaxies, while the M49 cloud contains a higher proportion of spirals (though the group's namesake is a huge elliptical). The two groups are characterized by different average radial velocities and spread of velocities.

The ellipticals and lenticulars in both groups are concentrated toward the centers of the groups; the dwarf spher-



Top: CCD image of supernova 1986G in NGC 5128. Star A has V magnitude 15.6; star B has V magnitude 15.8. Above: Photometric observation of the NGC 5128 supernova made in 1986. Figures from M. M. Phillips et al., PASP. Opposite page: Map of the Virgo Cluster showing luminosities of members. Bright pair near center is composed of M84/M86; bright galaxy to lower left of pair is M87. Bright galaxy at bottom center is M49. From Binggeli, et al., AJ.





Contour plot of M31 from Stephen Kent's photometric paper published in *AJ*. M32 appears at upper right. The photometric data for this plot were made with a Celestron 90mm catadioptric telescope.

oidal galaxies are likewise clustered around these luminous galaxies.

M87 has long been conjectured to be at the center of the cluster, if not in space, then as the center of the potential energy well into which other galaxies are falling or orbiting around. The relatively complete data set here suggests this cannot be so.

The overall irregularity in the cluster's structure, along with other lines of evidence, is consistent with the idea that the core and envelope of the cluster is still forming — the Virgo Cluster is young, at least in the astronomical sense. Given that a large proportion of rich clusters are irregularly structured, it may be generally true that clusters are younger than the galaxies that form them.

The main sequence of another globular cluster has been revealed ("CCD Photometry of the Globular Cluster M-68," Robert D. McClure, Don A. Vandenberg, R. A. Bell, James E. Hesser, and Peter B. Stetson, *AJ* 93:1144, May 1987). Using a CCD camera at the prime focus of the CTIO 4-meter telescope, the authors obtained V magnitudes and B-V colors for about 2,850 stars. The data include stars to about magnitude

2.4, but the magnitudes for individual stars are of good quality only to magnitude 22. Fainter than this the ensemble average is useful for defining the location of the cluster main sequence and determining the luminosity function.

The distance to the cluster was found to be about 11 kiloparsecs and the age set at 14 billion years. Both these values are dependent to some degree on the metal abundance assigned to the cluster stars, still an unyielding problem for both observers and theoreticians.

Some well-defined information about the ellipticities of globulars has been published by Raymond E. White and Stephen J. Shawl ("Axial Ratios and Orientations for 100 Globular Star Clusters," *AJ* 317:246, June 1, 1987). The data were extracted by applying image-processing techniques to POSS and ESO/SRC sky survey films.

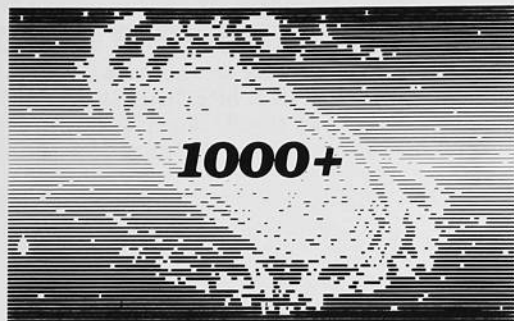
Many amateur observers have noticed that the visual outlines of globulars are sometimes distinctly oval. Sometimes this is clearly caused by the absorptive effects of dark clouds in the Milky Way. Yet others (like Omega Centauri) are clearly out-of-round even though they lie away from the galactic plane. White

and Shawl's results show that only one third of the clusters studied are more elongated than the ratio 9:10, and only 5 percent are flatter than 8:10. Most globulars are quite circular, the overall average axial ratio being 9.3:10.

The motions of stars in a large area of the association Cepheus OB2 have been determined by Laurence A. Marschall and William F. van Altena ("Membership in the Young Cluster Trumpler 37," *AJ* 94:71, July 1987). The cluster Tr 37 is probably no more than 1 million years old and forms the nucleus of the association overlaid by the large emission nebula IC 1396.

The article lists positions and coarse photographic photometry for nearly 1,400 stars and proper motions and membership probabilities for a subset of 1,153 stars to V magnitude 15. Of this sample, 486 have membership probabilities greater than 80 percent, which makes them near certain constituents of the cluster. This area is rich in double stars; most are shown to be real by their common motion but move faster than the cluster members, which places them clearly in the foreground.

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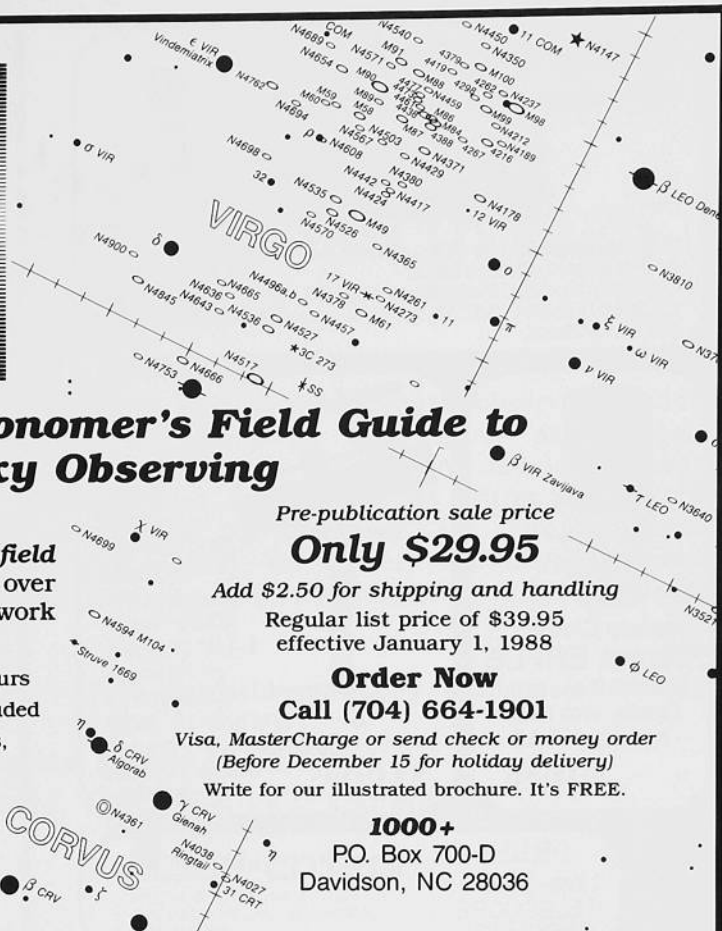


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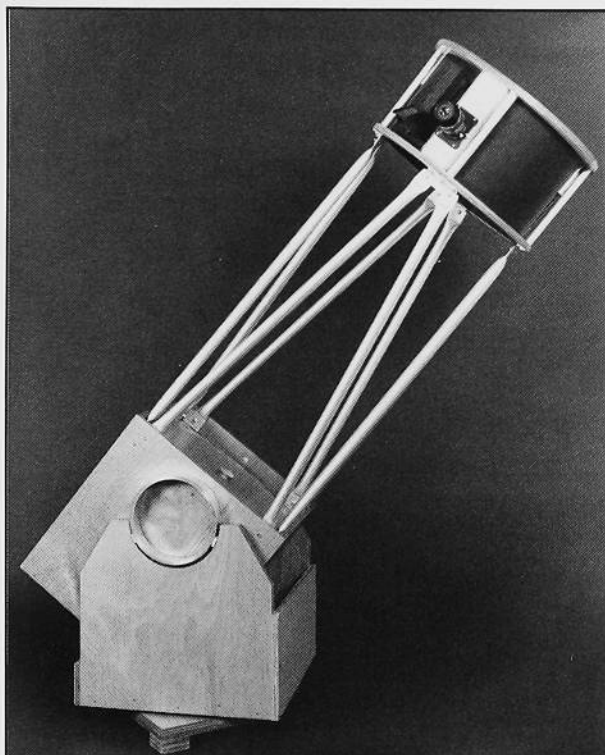
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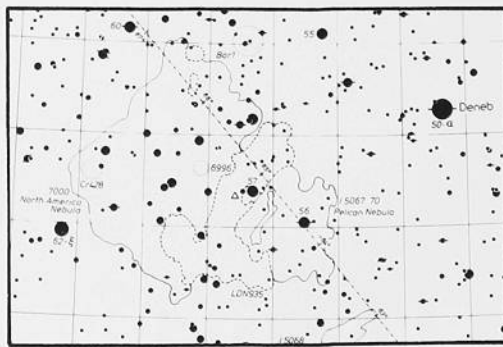
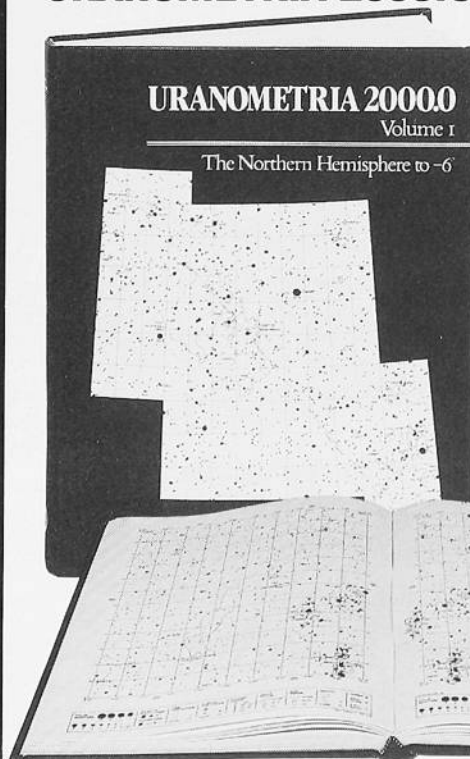
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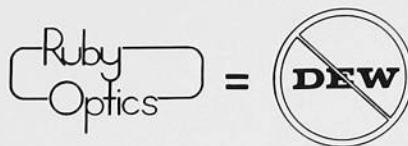


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